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EXPERIMENT STATION RECORD,

EDITED BY

A. C. TRUE, Ph. D., *Director*.

AND

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With the coöperation of the scientific divisions of the Department and the Abstract Committee of the Association of Official Agricultural Chemists.

LIST OF STATION PUBLICATIONS ABSTRACTED.

LIST OF UNITED STATES DEPARTMENT OF AGRICULTURE PUBLICATIONS ABSTRACTED.

EXPERIMENT STATION RECORD.

Vol. VI. No. 1.

With the beginning of the present volume of the Record the general arrangement of the abstracts has been materially changed. The topical arrangement, which heretofore has covered only the abstracts of station publications and the list of titles of recent investigations, has now been extended to the entire contents of the Record. Abstracts of station, Department, and foreign investigations are grouped together by subjects. Titles, reprints, and articles of less scientific interest are printed in brevier type and arranged at the end of the respective topics, thereby economizing considerable space. The list of the station publications abstracted is continued in the table of contents of each number, so that the account of the work of any station can be easily found.

The change in arrangement is intended to make the Record more convenient for reference and for general reading, to improve its general appearance, to economize space, and to provide for further extension of the subject matter. Abstracts and titles of articles on agricultural science in American publications will be included. It is the purpose to make the review of the literature in the several lines as comprehensive as practicable, so that this publication may be a record of the progress of agricultural science.

Under the new arrangement the scientific divisions of the Department will more definitely coöperate with this Office in the preparation of the Record.

The unpublished investigations of the late Prof. Gustav Kühn, for twenty-five years director of the experiment station at Möckern, Germany, have recently been compiled and published by his successor, Dr. O. Kellner.[1] These works cover a period of nearly twenty years, and represent a large part of the life-work of this eminent investigator. A list of Prof. Kühn's published works has already been given (E. S. R., 3, p. 837). The part now presented to the public is perhaps of even greater scientific value. It had been withheld from publication until results could be verified by further experiments or a series of investigations completed. In this respect it presents a striking example of

[1] Landw. Vers. Stat., 44.

the caution exercised by a thorough scientist in publishing the results of his investigation. It was not for a temporary success that he was striving, but for the demonstration of a principle that would bear the test of subsequent study. His work bears evidence of a well-defined plan, which was only interrupted by his sudden death.

The data for each experiment had been calculated, summarized, and filed with copious notes in a most orderly manner. In some cases the manuscript had been partially prepared for publication. The work of completing this task has fallen into able hands, and has been performed in a manner that makes the volume a most valuable contribution to the science of animal nutrition. Although only summaries of the data are given, the book covers 580 printed pages. It includes experiments on the digestibility of a large number of concentrated feeding stuffs and by-products, especially those obtained in the extraction of the volatile oil from seeds; an investigation of Stutzer's method of artificial digestion, with a comparison of the results of natural and artificial digestion, and a lengthy investigation, with the aid of the respiration apparatus, on the formation of fat in the body from the carbohydrates of the food, and on the relation of the food to the excretion of hydrocarbons.

Abstracts of some of these investigations are given in the present number of the Record.

In connection with the study on artificial digestion mentioned above, the history of the development of the method is interesting.

After some preliminary studies on the action of acid pepsin solution on the proteids of various materials. A. Stutzer[1] in 1880 proposed a method for determining the digestibility of protein outside the body. This consisted in digesting 2 gm. of a feeding stuff with 250 cc. of acid pepsin solution at the temperature of the body for 24 hours. He believed that this treatment dissolved the maximum amount of protein digestible. The portion dissolved he designated as the albuminoids of the material, and the portion undissolved he called "nuclein." The latter he believed to have no nutritive value for animals.

Soon after this T. Pfeiffer[2] compared the results of artificial digestion and natural digestion with sheep. His object was to determine whether the nuclein in the food was all excreted as such, or slightly changed, and whether this nuclein had any nutritive value. He found that more nitrogen was excreted than was accounted for by the nuclein in the food. Deducting the metabolic nitrogen in the feces, there was much less nitrogen than an equivalent of the nuclein. From 14 to 35 per cent of the nuclein was found to be digested by the animals; and the residue from pepsin digestion was found not to belong to the nuclein group at all. This led Stutzer[3] to revise his method and suggest the digestion

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[1] Jour. Landw., 28 (1880), pp. 195, 435; 29 (1881), p. 473.

[2] Jour. Landw., 31 (1883), p. 221.

[3] Ztschr. physiol. Chem., 9 (1885), p. 211.

with alkaline pancreas solution after the pepsin digestion. He found that when a digestive solution containing the pancreatic juice in proper concentration and with the proper amount of alkali (soda) was allowed to act directly upon the substance without previous treatment with pepsin it dissolved practically the same amount as pepsin; but when allowed to act upon the residue from pepsin digestion it dissolved from 20 to 30 per cent more of the protein. Consequently he believed that different groups of proteids were dissolved by pepsin and by pancreas, and that for the digestion to be complete pancreas digestion must follow the pepsin digestion. He described a method for artificial digestion in which this order of treatment was followed. The fact that direct treatment with pancreas dissolved practically the same amount as pepsin would seem to be opposed to Stutzer's conclusion that the two digestive solutions dissolved separate groups of proteids.

Pfeiffer[1] made further digestion trials in which he attempted to determine the metabolic nitrogen in the feces by treating the latter with pepsin solution. Taking this metabolic nitrogen into account, he found that the artificial digestion with pepsin and pancreas agreed with the natural digestion as closely as parallel experiments on animals. It was then confidently believed that the utility of Stutzer's new method was demonstrated, and that the method had been useful in calling attention to the error of determining digestibility by the natural method without taking the metabolic nitrogen into account. Since this time the metabolic nitrogen has frequently been taken account of in digestion experiments on animals and has sometimes been a convenient means of reconciling the differences between results on different animals. The investigations of Kühn, which are now published, throw a new light on the whole question. Kühn found that digesting 2 gm. of substance with 250 cc. of acid pepsin solution for 24 hours did not dissolve the total amount of pepsin-soluble nitrogen; but that to do this 500 cc. of pepsin solution must be used and the digestion continued for at least 48 hours. In the case of some materials which resist the action of pepsin solution, as the residues from the extraction of volatile oils from the seeds of umbelliferous plants, the digestion should be continued for 72 or 84 hours. He found by laboratory experiments and by experiments on animals that the action of the pancreas solution was due wholly to the soda added in its preparation, and was not therefore a true digestive process. The results of artificial digestion by his method, *i. e.*, 500 cc. of pepsin solution acting for 48 hours, agreed well with those by natural digestion; and the nitrogen dissolved from the residue of the pepsin digestion by treatment with pancreas solution was found to be indigestible to animals. Digestion with pepsin solution in the manner described, without subsequent digestion with pancreas solution, dissolved all of the protein of the feeding stuff which could be digested by animals. In the case of the residues from umbelliferous seeds, which, as mentioned above, resist the action of the pepsin,

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[1] Jour. Landw., 34 (1886), p. 425.

feeding experiments showed that they likewise resist the action of the digestive juices of the animal, and that not more protein was taken out in natural digestion than was dissolved by treatment for 84 hours in the manner described.

The results of Prof. Kühn's investigations suggest an interesting line of study. The omission of digestion with pancreas is a simplification of the method which will be welcomed by all who have occasion to make determinations of digestibility by artificial means. But the accuracy of the method proposed by Kühn needs to be demonstrated by experiments on a variety of materials in connection with trials on different kinds of animals. Doubtless other groups of feeding stuffs than the residues mentioned will be found to require special treatment in order to secure correct coefficients. The experience with the original method has shown the danger of too hasty conclusions. The wide interest manifested in the development of artificial digestion is evidence of the desirability of a reliable method for this purpose, even though it applies only to the protein. Such studies of methods of investigation form a legitimate and profitable line of work for the experiment stations.

AMERICAN DIGESTION EXPERIMENTS.

W. H. JORDAN.

The purpose of arranging the following summary of American digestion coefficients is to place them in a form convenient for reference and use. The amount of work performed in this direction, when collected in one mass, seems surprisingly large. We have for so long depended upon German averages as an aid in calculating feeding rations that we are slow, perhaps, in finding out the extent and value of our own figures. But for some foods, as will be pointed out, we have far better figures than any heretofore available.

Twelve American experiment stations have made digestion experiments. One hundred and fifty-four experiments, with as many distinct samples of foods, are included in this work as here presented, involving 312 single trials. The extent, character, and distribution of these experiments can best be seen, perhaps, in tabular form. Quite a number of experiments for determining the digestibility of rations are not included in this summary and a few are excluded that are considered defective.

Experiments by States.

Colorado	1	North Carolina	19
Maine	57	Oregon	1
Maryland	4	Pennsylvania	40
Massachusetts	10	Texas	3
Minnesota	5	Utah	2
New York	7	Wisconsin	5

Animals used.

	Experiments.		Experiments.
Cows	16	Sheep	83
Cow and goat	4	Steers	21
Goats	7	Steers and sheep	4
Goats and sheep	3	Swine	8

Distribution of experiments.

	Number of experiments.	Single trials.
A.—EXPERIMENTS WITH RUMINANTS.		
Green fodders:		
Grasses[1]	21	44
Legumes[2]	1	2
Silage:		
Grasses	17	37
Legumes	1	2
Dried fodders:		
Grasses	63	126
Legumes	10	20
Miscellaneous fodders	4	5
Roots	5	11
Grains	6	14
By-products	18	41
Total	146	302
B.—EXPERIMENTS WITH SWINE.		
Grains and by-products	8	10

[1] Under this term are included the corn plant and all other plants belonging to the grass family.
[2] Includes all plants belonging to the *Leguminosæ*.

It is noteworthy that 63 of the 146 experiments with ruminants were made with the corn plant as fodder—mostly with the whole plant—of various varieties and in various stages of development. This gives an amount of information in regard to the digestibility of this most important and peculiarly American product never before possessed, and which is based upon so many observations as to make it reliable for use in feeding practice.

The coefficients obtained for certain by-products are also new and important, as they show the digestibility of feeding stuffs that are peculiar to our markets, and are used especially by dairymen in very large quantities. This refers particularly to milling products and the wastes from the manufacture of glucose, starch, and vegetable oils, and includes bran and middlings from wheat, gluten "feeds," and the oil meals. The digestibility of separate species of the grasses and legumes has also been studied.

Much attention has been given to the influence of the stage of development of certain fodder plants upon their digestibility, as well as the effect in this direction of drying and ensiling.

Average digestion coefficients of American feeding stuffs as determined by American experiments.

	Number of States.	Number of samples.	Number of single trials.	Dry matter.	Ash.	Protein (N. × 6.25).	Fiber.	Nitrogen-free extract.	Fat.
A.—EXPERIMENTS WITH RUMINANTS.									
GREEN FODDER (fed when green).									
Corn (maize) fodder—									
Whole plant, average of all trials	2	15	30	68	35	61	61	74	74
Dent, immature, Pennsylvania	1	4	9	68	57	69	69	71	66
in milk, Pennsylvania	1	3	6	68	33	62	63	73	76
mature, Pennsylvania	1	7	13	67	22	53	54	75	78
Sorghum, North Carolina and Texas	2	2	4	67	42	47	59	74	74
Rye, Pennsylvania	1	1	2	73	56	79	79	70	74
Timothy (*Phleum pratense*), Utah	1	1	3	63	32	48	56	66	53
Hungarian grass (*Setaria italica*), Maine	1	1	4	63	41	62	68	66	52
Pasture grass, Pennsylvania	1	1	1	69	50	65	74	72	55
Red clover (*Trifolium pratense*)	1	1	2	66	55	67	53	78	64
SILAGE.									
Corn (maize) silage, whole plant—									
Average of all kinds	6	17	37	66	31	53	67	70	81
Dent, immature, Maine, New York, and Pennsylvania	3	5	12	64	33	49	71	66	75
Dent, in milk, Pennsylvania	1	3	8	65	32	50	65	69	87
Flint, mature, Maine and New York	2	4	10	73	30	63	75	77	83
Soja-bean silage	1	1	2	59	57	76	55	52	72
DRIED FODDERS (fed air-dry or partially so).									
Corn (maize) fodder, whole plant—									
Average of all kinds	4	24	50	66	34	55	66	69	72
Dent, immature, Maine and Pennsylvania	2	6	12	62	38	51	67	64	68
in milk, New York and Pennsylvania	2	5	12	63	31	45	64	66	76
mature, Pennsylvania	1	4	6	70	20	55	52	77	79
Flint, mature, Maine	1	4	9	71	42	65	76	73	70
Sweet, mature, Maine	1	3	6	67	36	64	74	68	74
Corn (maize) butts, Maryland	1	1	2	66	11	21	73	69	79
husks, Maryland	1	1	2	72	16	29	79	75	32
fodder, tops above ear, Maryland	1	1	2	55	7	22	70	53	63
pulled, Maryland, North Carolina, and Texas	3	3	6	60	......	51	69	63	64
stover, Pennsylvania	1	1	4	62	45	52	66	64	52
Sorghum fodder, leaves, North Carolina	1	1	2	63	29	61	70	64	47
Oat straw, Maine	1	1	2	50	......	......	58	53	38
Hay from grasses named:									
Barley, Maine	1	1	4	61	45	65	62	63	40
Blue joint (*Calamagrostis canadensis*), Maine	1	2	3	54	29	63	54	56	45
Cat-tail millet (*Pennisetum spicatum*), North Carolina	1	1	2	62	68	63	66	59	46
Hungarian grass (*Setaria italica*), Maine	1	1	2	65	47	60	68	67	64
Johnson grass (*Sorghum halepense*), North Carolina	1	1	1	54	56	45	58	54	39
Orchard grass (*Dactylis glomerata*), Maine and New York	2	2	3	56	......	59	60	55	54
Redtop (*Agrostis vulgaris*), Maine	1	2	3	60	29	61	61	62	50
Timothy (*Phleum pratense*), average of all kinds, Maine and Utah	2	10	22	58	37	49	53	63	57
in full bloom, Maine	1	3	5	61	44	57	59	64	56
late cut, Maine	1	3	5	54	32	45	48	61	51
Wild-oat grass (*Danthonia spicata*), Maine	1	2	2	64	35	58	68	65	50
Witch grass (*Triticum repens*), Maine	1	2	3	61	41	58	63	65	57
Pasture grass, Pennsylvania	1	2	3	72	52	73	76	74	67
Mixed grasses, New York and Pennsylvania	3	4	9	56	......	51	55	59	52
Hay from legumes named:									
Alfalfa, Colorado and New York	2	2	3	58	......	73	46	68	51
Alsike clover (*Trifolium hybridum*), Maine	1	2	3	62	52	66	53	71	50
Crimson clover (*Trifolium incarnatum*), North Carolina	1	1	2	61	53	69	46	70	46

Average digestion coefficients of American feeding stuffs as determined by American experiments—Continued.

	Number of States.	Number of samples.	Number of single trials.	Dry matter.	Ash.	Protein (N. × 6.25).	Fiber.	Nitrogen-free extract.	Fat.
A.—EXPERIMENTS WITH RUMINANTS—Cont'd.									
DRIED FODDERS—continued.									
Hay from legumes named—Continued.									
Red clover (*Trifolium pratense*), Maine and Wisconsin	2	2	7	53	......	52	47	61	48
White clover (*Trifolium repens*), Maine	1	1	1	66	58	73	61	69	51
Cowpea vines, North Carolina	1	1	2	59	49	65	42	71	52
Soja-bean vines, North Carolina	1	1	2	62	......	71	61	69	29
MISCELLANEOUS FODDERS.									
Buttercup hay (*Ranunculus acris*), Maine	1	1	1	56	48	56	41	67	70
Peanut-vine hay, North Carolina	1	1	2	60	20	63	52	69	66
Sorghum bagasse, North Carolina	1	1	1	61	13	14	46	65	64
White weed, white daisy (*Chrysanthemum leucanthemum*), Maine	1	1	1	58	52	58	45	67	62
ROOTS.									
Sugar beets, Maine	1	1	2	94	32	91	100	100	50
Mangel-wurzels Maine	1	1	2	78	16	75	43	91	......
Ruta-bagas, Maine	1	1	2	87	31	80	74	95	84
Turnips (strap leaf), Maine	1	1	2	93	59	90	100	96	97
Potatoes, Maine	1	1	3	77	......	44	......	91	13
GRAINS (fed whole or ground).									
Corn-and-cob meal, North Carolina	1	1	3	79	......	52	45	88	84
Corn meal, North Carolina and New York	2	2	5	87	......	60	......	92	92
Cotton seed, raw, North Carolina	1	1	2	66	43	68	75	50	87
roasted, North Carolina	1	1	2	56	......	47	66	51	72
Pea meal, Maine	1	1	2	87	44	83	26	94	54
BY-PRODUCTS.									
Brewers' grains, dried, Massachusetts	1	1	2	62	......	79	53	59	91
Corncobs, Massachusetts	1	1	2	59	......	17	65	60	50
Cotton-seed hulls, North Carolina and Texas	2	3	11	41	24	10	38	40	77
meal, North Carolina and Wisconsin	2	2	7	76	......	88	......	64	97
Gluten feed (Buffalo), Massachusetts	1	1	2	78	......	85	43	81	81
meal, Maine	1	1	2	87	......	87	......	91	88
Linseed meal, new process, Massachusetts	1	1	2	81	......	87	61	86	91
old process, Massachusetts	1	1	2	79	......	89	57	78	89
Malt sprouts, Wisconsin	1	1	1	67	......	80	33	68	100
Wheat bran, Maine and Massachusetts	2	4	7	61	......	78	25	68	72
middlings, Maine and Massachusetts	2	2	4	79	......	82	......	88	85
B.—EXPERIMENTS WITH SWINE.									
GRAINS AND BY-PRODUCTS.									
Barley, Minnesota	1	1	1	80	5	81	48	87	67
Corn (maize) (whole kernel), Maine and Minnesota	2	2	2	86	......	79	44	91	62
meal, Maine	1	1	1	89	......	86	29	94	82
Corn-and-cob meal, Maine	1	1	1	76	......	76	28	84	82
Peas, Minnesota	1	1	1	90	40	89	78	95	50
Wheat shorts, Minnesota	1	1	2	76	5	73	36	87	......
Wheat bran, Minnesota	1	1	2	61	......	75	33	66	72

RECENT WORK IN AGRICULTURAL SCIENCE.

CHEMISTRY.

Sixth Annual Meeting of the Association of German Agricultural Experiment Stations (*Landw. Vers. Stat., 43* (*1894*), *No. 5, pp. 321–374*).—The sixth annual meeting of this association was held at Würzburg, September 8 and 9, 1893, and was presided over by F. Nobbe.[1] The following is a brief summary of the proceedings as affecting methods of analysis:

Examination of Thomas slag.—The use of concentrated sulphuric acid as a solvent for Thomas slag, as proposed by G. Loges, was adopted as the official method without debate. The recommendations of the previous meeting regarding the valuation of fine meal and phosphoric acid in Thomas slag were also adopted after brief discussion.

Determination of phosphoric acid.—Comparative tests by 34 stations of the molybdic methods of Fresenius, Wagner, and Maercker, and of the citrate method on a solution of sodium phosphate are reported by H. Schultze and the results discussed by several others. The recommendation of the reporter that these methods, and especially Neubauer's method, be referred to the section on fertilizers for further study was adopted. A motion that similar comparative tests of the methods of nitrogen and potash determination be carried out was also adopted.

Determination of nitrogen in nitrate of soda.—After general discussion of methods, the following recommendation of Müller was adopted: The nitrogen in nitrate of soda is to be determined by a direct method; in addition to Kühn's method, the methods of Ulsch, Jodlbauer, Förster, and Schlösing-Grandeau may be used. Baumert specially commended the Ulsch method, while Stutzer and Wagner maintained that the aluminum method is unreliable. Stutzer called attention to the variations in the methods of examination of nitrate of soda employed by the German Agricultural Council, the German Agricultural Society, the Association of Experiment Stations, the German Fertilizer Manufacturers' Union, and the Union of Wholesale Fertilizer Dealers. He claimed that the old difference method is still extensively used, and that during the past year the nitrogen content of nitrate of soda, as indicated by this method, often fell below 15.5 per cent on account of the fact that the nitrate contained a considerable percentage of potash. In order that no injustice might be done, he recommended that where a guaranty of 15.5 per cent of nitrogen is given a variation of 0.25 per cent of nitrogen be allowed until July 1, 1894.

[1] For proceedings of the fifth annual meeting, see E. S. R., 4, p. 979.

Analysis of potash salts.—The only recommendation reported under this head was that of F. Nobbe that the Kali Syndicate of Stassfurt be allowed a representative in the permanent section of the association, which was adopted.

Fertilizer control.—The form of contract between fertilizer manufacturers or dealers and the experiment stations, and the plan of adjustment of differences regarding fertilizer analyses adopted at the last meeting, was discussed and modified to some extent, but the essential features, as heretofore published in the Record, remain the same.

Soil analysis.—A. Emmerling reported on the methods proposed by J. Kühn at the previous meeting. The principal modifications of Kühn's methods proposed were changes in the classification of the soil particles and the substitution of Wagner's modification of Kühn's elutriation cylinder for the original Kühn cylinder. The classification proposed is as follows:

Over 5 mm. diameter, stone, gravel, etc.
5–2 mm. diameter, "grand."

Fine earth:
- 2–1 mm. diameter, very coarse sand.
- 1–0.5 mm. diameter, coarse sand.
- 0.5–0.2 mm. diameter, medium sand.
- Under 0.2 mm. diameter, fine sand.
- Suspended matter (very fine sand, silt, clay, etc.).

For chemical analysis it was recommended that the fine earth obtained by sifting the dry soil through a 2 mm. sieve be used.

A simple method of determining the volume of soil was described by R. Heinrich, as follows: An amount of fine earth corresponding to 100 gm. of dry substance is placed in an ordinary burette filled to the first mark with white sand, and then saturated with water. After the excess of water is drained off the volume is read from the scale.

On motion of Wagner, the methods recommended were ordered to be subjected to trial during another year, and on motion of Klein, it was directed that trials of Schöne's apparatus be included in the comparative tests.

Seed control.—After a report by Nobbe was read and discussed a permanent section on seed-testing was appointed, consisting of three members, for the purpose of improving methods, and especially of securing uniformity. This committee consists of Nobbe, Heinrich, and Dietzell.

Analysis of feeding stuffs.—The recommendations of the reporter on this subject, A. Emmerling, after full debate and amendment by H. Schultze and G. Loges, were adopted, as follows:

(1) The qualitative examination of feeding stuffs for sand as well as mineral adulteration is made obligatory, and when the preliminary test indicates the presence of more than normal amounts, quantitative determination by incineration and extraction with hydrochloric acid is to be carried out and the results reported when the content of these materials is 1 per cent or more.

(2) The permanent section on feeding stuffs recommends that in each

fodder analysis an examination should be made for noxious weed seed. The presence of such indicates whether the material has been adulterated, as for instance with grain refuse. It is not necessary to determine the number and the kind of weed seed and to calculate their proportion per kilogram.

(3) If a microscopic examination of the feeding stuff shows an unusual amount of smut spores, this fact should be reported as well as the possible danger from this source.

The recommendation that feeding stuffs be examined for ergot was referred to the section on feeding stuffs for further investigation.

A discussion of the food value of the carbohydrates was postponed, at the suggestion of the reporter, until more preliminary work has been done on this subject.

Determination of the specific gravity of curdled milk, M. WEIBULL (*Milch Ztg., 23 (1894), No. 16, pp. 247, 248*).—In a previous article[1] the author stated as the result of experiments that when a definite volume of ammonia was added to curdled milk the contraction in volume was so slight that the specific gravity of the milk could be calculated with the formula:

$$\text{Vol. of ammonia} \times \text{sp. gr. of ammonia} + \text{vol. of milk} \times \text{sp. gr. of milk} = \text{vol. of the mixture} \times \text{its sp. gr.}$$

As the specific gravity of the milk is the only unknown factor this is easily calculated.

The method has since been tested by J. Okulitsch,[2] who invariably obtained too low results. The samples tested by him were rather high in specific gravity, and he used only 3 per cent ammonia.

The author then made a second series of experiments with 22 samples, using different amounts of ammonia, which he reports in the present paper. The specific gravity was determined with a Westphal balance and with a picnometer, and the mixture was allowed to stand an hour or so after adding the ammonia to allow the air bubbles to rise. The author's conclusions from the experiments are that—

(1) The specific gravity of normal milk which has stood for 1 or 2 weeks and curdled can be accurately determined by the method given.

(2) With the addition of common ammonia equal to one tenth of the volume of the milk, the error does not exceed 0.0005 in careful work.

(3) Owing to the contraction the results are more likely to be slightly too high than too low.

(4) In accurate work it is advisable not to materially exceed the amount of ammonia mentioned, since the error in reading is then multiplied, and the reduction to 15° C. is more difficult, as the tables for conversion do not include the figures for such thin milk.

Determination of fat in cheese, F. H. WERENSKIOLD (*Rpt. Chem. Control Sta. Christiania, 1893, pp. 28, 29*).—Comparative determina-

[1] Chem. Ztg., 17 (1893), p. 1670; abs. in Milch Ztg., 22 (1893), p. 786.
[2] Milch Ztg., 23 (1894), p. 84.

tions of fat in a sample of reindeer cheese were made in duplicate by the following three methods: (1) A weighed quantity of cheese was pulverized with sand, dried at 100° C., and extracted with ether; (2) the cheese was cut into very thin slices, dried directly at 100° C., and extracted with ether; or (3) the cheese was cut into very thin slices and kept in a desiccator until almost dry, and then extracted with ether. Five grams of cheese were taken for each determination. The duplicate determinations by the first method gave 41.64 and 42.40 per cent of fat, respectively; by the second method, 41.92 and 42.34 per cent; and by the third method, 43.11 and 43.11 per cent. The last method gave the best results, but it required more time than the other methods. In some cases it is the only available method, since very watery cheese melts in drying by heat to a mass which can not be pulverized and from which the fat can not be completely extracted. The cheese in question had about 28 per cent of water.—F. W. WOLL.

Investigations on the artificial digestion of the protein in feeding stuffs, G. KÜHN *et al.*, reported by O. KELLNER (*Landw. Vers. Stat.*, *44*, *pp. 188–256*).—These experiments were made between 1882 and 1892. The earlier ones were on the method of artificial digestion, *i. e.*, the quantity of pepsin solution, the duration of digestion, and the acidity of the digestive solution.

With reference to the first point, trials were made with hay, peanut cake, and the residue from the extraction of the volatile oil from caraway seed, using 2 gm. of substance and from 250 to 600 cc. of pepsin solution containing 1 per cent of HCl, and allowing the latter to act from 24 to 48 hours. Increasing the solution to 500 cc. and allowing it to act for 48 hours both increased the nitrogenous matter dissolved, but increasing the pepsin solution to 600 cc. had little, if any, effect. Consequently in later experiments 500 cc. of pepsin solution and 2 gm. of substance were used.

As to the duration of the action, the nature of the substance was found of importance. For coarse fodders, as different kinds of hay and straw, and such concentrated foods as brans, brewers' grains, oil cakes, and ground meat, 48 hours was ample, and increasing the time did not increase the protein dissolved. But for the residues from the extraction of the volatile oils from anise, caraway, fennel, and coriander seeds an increase up to 84 hours was advantageous; and although the time was not extended further, feeding trials showed that not more protein was digested from these residues than was dissolved by 84 hours' treatment. It is explained that the long treatment required is due to the resin in the seeds of umbelliferous plants. This is held in solution by the volatile oils, and when these are removed by treatment with steam, the resin dries down and makes the cells quite impervious to the solution.

In the third series, pepsin solutions were used containing 1 and 2 per cent of HCl, respectively, at the close of the digestion; and 500 cc. of solution was allowed to act 48 hours. On coarse fodders, oil cakes,

brans, and brewers' grains, 1 per cent of HCl was as effective as 2; but on the residues of umbelliferous seeds 2 per cent of HCl was considerably more effective.

The conclusion from the experiments was that Stutzer's method should be modified so as to allow 500 cc. of the pepsin solution with 1 per cent HCl to act on 2 gm. of substance for at least 48 hours, and in the case of materials like the residue of umbelliferous seeds, which present an unusual resistance to the solution, 72 or 84 hours.

It will be remembered that Stutzer first proposed to digest with pepsin solution for 24 hours, and when it was found that the results were lower than in digestion trials with animals he proposed to follow the pepsin digestion with alkaline pancreas digestion. Experiments were made by the authors to determine whether the favorable action of the pancreas solution was due to the soda it contained. In these the pepsin digestion was followed by digestion with alkaline pancreas solution or with soda solution of equal strength. Excluding the residues of umbelliferous seeds, it was found that, as a rule, when the Kühn method (mentioned above) was followed the action of the pancreas was apparently due to the soda it contained. In the case of umbelliferous seed residues the results were irregular.

Twenty-two digestion experiments were made with oxen to compare the results of natural and artificial digestion, and to test the accuracy of Pfeiffer's statement that animals digest more protein than is dissolved by digestion with pepsin alone.[1] These experiments were with hay and rice meal, cotton-seed meal, ground meal, or aniseed residue; and the artificial digestion was according to Kühn's method. They showed that Pfeiffer's conclusions were wrong. The protein insoluble in pepsin (by Kühn's method) was all voided by the animals, indicating that pepsin dissolves all that can be digested by ruminants. In the method of artificial digestion followed by Pfeiffer not all of the pepsin-soluble protein was dissolved. In other experiment the feces were digested with pepsin (Kühn's method) and pancreas solutions, and the food was submitted to like digestion. The amount of nitrogen left undissolved by this digestion was greater in the feces than in the food; in other words, this artificial digestion with pepsin and pancreas dissolved more protein than was actually taken out by natural digestion and by subsequent treatment of the feces. If the nitrogen dissolved from the food by alkaline pancreas was really digestible, then it would have been taken up by the animal and the total amount of pepsin-insoluble nitrogen would not have reappeared in the feces, as was the case. Hence the conclusion from both laboratory experiments and experiments on animals is that when all of the pepsin-soluble nitrogen of a food is dissolved by artificial digestion, a further solution by treatment with alkaline pancreas is not a true digestive action, but is only a result of the solvent action of the soda added in the prepara-

[1] Jour. Landw., 31, p. 221.

tion of the pancreas solution. In the case of aniseed residue, which, as mentioned above, resisted the action of pepsin solution, all of the pepsin-insoluble nitrogen of the food passed into the feces, showing that in the case even of umbelliferous seed residues natural digestion was not more effective than artificial digestion by Kühn's method.

The main points brought out by these investigations are that in artificial digestion of feeding stuffs 500 cc. of pepsin solution with 1 per cent of HCl should be allowed to act on 2 gm. of substance for at least 48 hours; that in some cases the action should be prolonged to 84 hours; that treatment with alkaline pancreas solution appears to be superfluous, and the action due alone to the soda in the solution; that the nitrogen dissolved by alkaline pancreas solution is not digestible by ruminants; that animals do not digest more than is dissolved by pepsin solution by Kühn's method; and that Kühn's method gives the amount of digestible protein in ordinary feeding stuffs.

Effect of chloroform on artificial digestion with pepsin, DUBS (*Virchow's Arch. path. Anat. and Physiol., 134, pp. 519–540*).—Experiments were made on the effect of chloroform on the digestion of albuminoids by a hydrochloric acid solution of scale pepsin and a hydrochloric acid extract of the lining of the stomach. In small doses—that is, 0.23 to 0.36 per cent—chloroform was found to promote the solvent action of the scale pepsin, but in large doses it checked the action. The effect of chloroform on the hydrochloric acid extract of the stomach was the same, except that larger doses were required to check the action, about 0.7 per cent of chloroform promoting the solvent action in this case. This difference is believed to be due to the presence of albuminoid bodies in the pepsin prepared directly from the stomach. The difference was more pronounced the larger the amount of these albuminoid bodies present. Conducting á current of air through the digestive solution had an unfavorable effect on the artificial digestion, which was more marked in the case of the scale pepsin. Aside from the above action, chloroform in a large excess, had a purely mechanical influence, weakening the digestive solution by separating the pepsin.

Report of the convention of the Association of Austrian Food Chemists and Microscopists in Vienna, May 10 and 11, 1894 (*Chem. Ztg., 18 (1894), No. 41, pp. 763–766*).

A new chemical element (?), K. J. BAYER (*Chem. Ztg., 18 (1894), No. 37, pp. 671, 672*).

Concerning the hydrogen peroxide of the atmosphere, E. SCHÖNE (*Ber. deut. chem. Ges., 27 (1894), No. 9, pp. 1233–1235*).

The chemistry of plant cell membranes, part III, E. SCHULZE (*Ztschr. physiol. Chem., 19, pp. 38–69; abs. in Bot. Centbl., 58 (1894), No. 6, pp. 209, 210*).

On the chemistry of chlorophyll, E. SCHUNCK and MARCHLEWSKI (*Ann. Chem., 278 (1894), No. 3, pp. 329–345*).

Concerning the nucleo-proteids, O. HAMMARSTEN (*Upsala läkareforenings förhandlingen, 1893, pp. 1–18; abs. in Centbl. agr. Chem., 23, No. 5, pp. 301–303*).

Note on lemon and orange peel, E. G. CLAYTON (*Analyst, 1894, June, p. 134.*)

A new method for determining albumen, F. KLUG (*Centbl. Physiol., 1893, p. 227; abs. in Ztschr. analyt. Chem., 33, No. 3, p. 380*).

Recognition of coloring matter in butter (*Abs. in Molk. Ztg., 8 (1884), No. 20, p. 291*).

Determination of fat in cheese, S. BONDZYNSKI (*Ztschr. analyt. Chem., 33, No. 2, pp. 186–189*).

A new method for determining the fat content of milk, FROHWEIN (*Molk. Ztg., 8 (1894), No. 22, pp. 323, 324*).

Comparison of the Soxhlet and the Liebermann and Székely methods for determining fat in milk, V. VEDRÖDI (*Ztschr. Nahr. Hyg. Waar., 8, pp. 92–95; abs. in Chem. Centbl., 1894, I, No. 20, p. 976*).

The analytical and technical examination of fats and naphtha products, D. HOLDE (*Chem. Ztg., 18 (1894), No. 38, pp. 704–709*).

The causes of errors in the chemical analysis of flours and the means of removing the same, BALLAND (*Rev. Internat. Falsif., 7 (1894), No. 9, p. 146*).

Means of studying and distinguishing between different kinds of meal, E. SPAETH (*Ztschr. angew. Chem., 1894, No. 10, pp. 295–297*).—After a brief review of other methods the results of refractometer tests of the fat are reported. The method promises to be useful in connection with other tests.

Progress in the examination of spices and their adulteration, T. F. HANAUSEK (*Chem. Ztg., 18 (1894), No. 39, pp. 723–726*).

Observations on the detection of cotton oil in lard, E. J. BEVAN (*Rev. Internat. Falsif., 7 (1894), No. 9, pp. 148, 149*).

Means of distinguishing oils, E. MINGIOLE (*L'Agr. e Ind. Agr., 27 (1894), No. 9, pp. 139, 140*).

Concerning the elementary composition of the oil of colza, G. PONZIO (*Gazz. Chimica Ital., 1893, No. 12, pp. 595–597; abs. in Staz. Sper. Agr. Ital., 26 (1894), No. 3, pp. 287, 288*).

The feeding value of dried beet chips (*Tidskr. Landtmän, 15 (1894), pp. 217–220*).

On the analysis of plant seeds, E. SCHULZE (*Chem. Ztg., 18 (1894), No. 43, pp. 799–802*).—A review.

Determination of starch in compressed yeast, F. FILSINGER (*Chem. Ztg., 18 (1894), No. 40, p. 742*).

Determination of nitric nitrogen in water in the state of bioxide of nitrogen, A. BARILLE (*Bul. Soc. Chim. Paris, 11–12 (1894), No. 10, p. 434*).

On the reliability of the determination of phosphoric acid as magnesium pyrophosphate (*Ztschr. analyt. Chem., 33, No. 3, pp. 362–370*).—Résumé.

Volumetric determination of phosphoric acid, A. F. HOLLEMAN (*Ztschr. analyt. Chem., 33, No. 2, pp. 185, 186*).

A laboratory vacuum apparatus for evaporation, SOXHLET (*Chem. Ztg., 18 (1894), No. 39, pp. 721–723, fig. 1*).

A simple apparatus for the extraction for analysis of gases dissolved in water, S. HARVEY (*Analyst, 1894, June, pp. 121–124, fig. 1*).

Note on an improved specific gravity bottle, H. LOUIS (*Jour. Soc. Chem. Ind., 13 (1894), No. 4, p. 322, figs. 2*).—The bottle is fitted with a ground-glass cover for the stopper, which prevents evaporation from the capillary tube.

BOTANY.

The assimilation of free nitrogen in the plant kingdom, B. FRANK (*Bot. Ztg., 51 (1893), pt. 1, No. 9, pp. 139–156; abs. in Forsch. Geb. agr. Phys., 16 (1893), No. 5, pp. 475–477*).—The author reviews and criticises adversely the work of Kossowitsch and Hellriegel, and

claims that the power to assimilate free nitrogen is an almost universal one, being possessed by many orders of plants besides the *Leguminosæ*. He summarizes his own results as follows:

(1) Legumes assimilate free nitrogen even when not in symbiotic relation with the tubercle fungus.

(2) The symbiotic fungus when cultivated apart from the host plant develops vigorously when it is supplied with organic combined nitrogen, but only feebly in free nitrogen.

(3) The amount of nitrogen which accumulates in the root tubercles is not sufficient to supply the amount which mature legumes, even when grown in soil free from nitrogen, possess in their seeds and other organs. The tubercles can not hold all the assimilated nitrogen, but must give it up to the plant; of this and the way it is effected there is as yet no evidence.

(4) Non-leguminous plants assimilate free nitrogen as follows: Fungi, algæ, mosses, *Oscillaria*, *Nostoc*, *Ulothrix*, and flowering plants as oats, buckwheat, spurry, *Brassica napus*, white mustard, potato, and *Acer platanoides*.

(5) The value of nitrates applied to the soil is best shown when the plants are small and the power of assimilation still weak.

The author claims that the ability to assimilate free nitrogen is more widely spread in the plant world than that of carbonic acid assimilation, but that it varies in degree according to the kind of plant. That it is assimilated as well by the alga as the fungus, and that assimilation of free nitrogen is a function pertaining to active protoplasm and the place of assimilation is in no particular plant organ, but in all the cells under certain conditions.

The influence of city fog on cultivated plants, F. W. OLIVER (*Abs. in Forsch. Geb. agr. Phys.*, *16* (*1893*), *No. 5*, *pp. 496*, *497*).—The author found by his investigations that city fog has a twofold influence on plants. The first is that it causes the light to be so greatly diffused that the chlorophyll activity is interfered with and starch production is greatly reduced; and the second is the direct injury done to plants by sulphurous acid, hydrocarbons, and other poisonous substances held in the fog. If a sound plant be brought into an atmosphere charged with sulphurous acid, as in the case of thick fog, it will quickly die without dropping its leaves. In dilute sulphurous acid the green of the leaves gradually disappears until the plant resembles one grown in the dark or in a greatly diffused light. Through the darkness due to the fog the protoplasm becomes less efficient against injurious influences and the death of the leaves is hastened. Ferns and other shade-loving plants are less influenced by city fog than plants requiring sunshine, and monocotyledonous plants less than dicotyls.

The principal effect sulphurous acid exerts upon plants is that it causes a shrinking of the protoplasm of the cells, gaining access to

them through the stomata of the leaves. In addition to the compounds already mentioned, the author investigated the action of pyridine, analine, and phenol, all of which he found to have a detrimental effect on vegetation.

The effect of city fog on flowers and flower buds was observed to be as injurious as in the case of the leaves.

A study of the constituents of the nodes and internodes of the sugar cane, J. L. BEESON (*Amer. Chem. Jour., 16 (1894), No. 6, pp. 457–464*).—The author reports his investigations on the source of the reducing sugar found in the expressed cane juice. It is the common belief that the nodes are the main source of the reducing sugar, but numerous analyses show by comparing the nodes with the internodes that the higher percentage is found in the internodes. The author summarizes as follows:

"It has been found in the course of this investigation that the juice of the nodes of the cane is quite different from that of the internodes, containing markedly less reducing sugars, more 'solids not sugar,' and more coagulable bodies; that the 'fiber' of the nodes contains more albuminoids, more insoluble carbohydrates not sugars which readily pass into reducing sugars; that as the cane deteriorates reducing sugars are formed more rapidly in the nodes than in the internodes, and that probably gluclose is the first visible product of plant assimilation by the young cane. In our opinion these facts can be best explained by the hypothesis that the physiological function of the node in the cane is similar to that of the seeds in the case of flowering plants—to store food in the region of the eye for the use of the young plant before it has taken sufficient hold of the earth to draw sustenance from the atmosphere and soil. This hypothesis is further confirmed by the fact that the isolated nodes of the cane when planted will germinate and grow to maturity.

"If this be true in regard to the cane, it may be true also in the case of all varieties of plants which propagate from the nodes or joints."

The perennity of mycelium, E. ROZE (*Bul. Soc. Mycol. France, 10 (1894), No. 2, pp. 94–97*).—The author found several specimens of *Peziza coccinea* during the month of February, and this led him to investigate the subject of the perennity of the mycelium of a large number of mushrooms. He gives a preliminary list of genera and species of *Basidiomycetes* having a perennial mycelium, and requests the reporting to him of others when observed.

Sexual reproduction of fungi, P. A. DANGEARD (*Le Botaniste, 1893, 6, pp. 221; abs. in Bot. Centbl., 58 (1894), 10, pp. 324–327*).—An account of the methods of reproduction in *Ustilago*, *Doassansia*, *Entyloma*, *Urocystis*, and *Tilletia*.

The irritability of plants, W. PFEFFER (*Verhandl. Ges. bot. deut. Naturforsch. und Aerzte, 1893; abs. in Bot. Ztg., 52 (1894), pt. 2, No. 2, pp. 22–24*).

The chemical irritability of fungi, M. MIYOSHI (*Bot. Ztg., 52 (1894), pt. I, No. 1, pp. 1–27; abs. in Bot. Centbl., 58 (1894), No. 5, pp. 161–164*).

Effect of the so-called chemical intensity of light on the growth of plant organs, J. WIESNER (*Sitzungsber. Wiener Akad. Wissensch., 102, I, p. 201; abs. in Naturwiss. Rundsch., 9, pp. 160–162, and Chem. Centbl., 65 (1894), I, No. 19, p. 909*).

The influence of mechanical strain on the growth of plants, R. HEGLER (*Cohn's Beiträg. Biol. Pflanze, 6 (1893), pp. 382–432; abs. in. Bot. Centbl., 58 (1894), No. 9, pp. 299–301*).

Morphological studies of Umbelliferæ, L. G. DE LAMARTIERE (*Paris: 1893, pp. 200; abs. in Bot. Centbl., 58 (1894), No. 6, pp. 215–218*).

Can white mustard (Sinapis alba) assimilate nitrogen? B. HANSTEEN (*Tidskr. norske Landbr., 1 (1894), pp. 121–125*).

Notes on a rapid method of hardening and preparing tissues for microscopic examination, J. COATS (*Jour. of Path., 2 (1894), No. 4, pp. 492–495*).

Reversion in plants, L. BRETON (*Rev. Eaux et Forêts, 33 (1894), No. 9, pp. 210–213*).

Concerning Oryza clandestina, F. BUCHENAU (*Bot. Ztg., 52 (1894), pt. 1, No. 4, pp. 83–96*).

New and noteworthy grasses, F. LAMSON-SCRIBNER (*Torrey Bul. 21, pp. 228–230*).

BACTERIOLOGY.

The physiological action of the soluble products of certain bacteria, especially Staphylococcus pyogenes aureus, J. SALVIOLI (*Berl. klin. Wochenschr., 31, pp. 307–309; abs. in Chem. Centbl., 1894, I, No. 21, p. 1006*).

Concerning the decomposition of amygdalin by means of microörganisms, C. FERMI and G. MONTESANO (*Centbl. Bakt. u. Par., 15 (1894), No. 19 and 20, pp. 722–727*).

An apparatus for culture of anaërobic bacteria, ZETTNOW (*Centbl. Bakt. u. Par., 15 (1894), No. 17, pp. 638–642*).

The period of incubation of microörganisms of the air and water in nutritive gelatin (*Ann. Micrographie, 1894, 3, pp. 111–118*).

Concerning gelatin preparations, H. TIMPE (*Centbl. Bakt. u. Par., 15 (1894), No. 17, pp. 644–647*).

An improvement in plate cultures, E. FREUDENREICH (*Centbl. Bakt. u. Par., 15 (1894) No. 17, pp. 643, 644*).

The rôle of microbes (*Rev. Scientif., 1894, 10, pp. 289–294*).

Sachsia, a new genus of yeast-like fungus, J. C. BAY (*Ber. deut. bot. Ges., 12 (1894), No. 4, pp. 90–93*.

Behavior of cholera bacilli in milk and dairy products, H. WEIGMANN and G. ZIRN (*Landw. Wochenbl. Schles. Holst., 1894, No. 19, pp. 298, 299*).

METEOROLOGY.

Notes on climate of Wyoming, B. C. BUFFUM (*Wyoming Sta. Bul. 17, pp. 36–45*).—Observations during 1893 on temperature, barometric pressure, precipitation, humidity, dew-point, movement of wind, terrestrial radiation, evaporation, and soil temperatures at Laramie, and on temperature and precipitation at Lander, Saratoga, Sheridan, Sundance, Wheatland, Bates Park (Freeland), and Inyan Kara are summarized. The general summary for the year is as follows:

Annual summary of meteorological observations in Wyoming.

	Laramie.	Lander.	Saratoga.
Temperature (degrees F.):			
Highest	87.2 (July 21)	94 (July 19)	89 (July 21)
Lowest	—9.2 (Feb. 27)	—10 (Feb. 14)	—13 (Jan. 16)
Highest daily range	45 (Sept. 14)	45 (Jan. 26)	53 (Jan. 30)
Lowest daily range	0.5 (Dec. 2)	3 (Mar. 22)	5 (Apr. 25)
Highest annual mean	....	....	....
Lowest annual mean	....	....	39.3
Frosts	June 6 and Aug. 16	May 24, 25, 26, 27, Sept. 22, 23.	June 14, 24, Aug. 15, 27.
Precipitation (in.):			
Lowest annual	3.48	....	....
Terrestrial radiation:			
Highest	11 (Sept 8)	....	....
Lowest	0 (Feb. 1, Apr. 25, May 6).	....	....
Mean relative humidity	56.9	....	....
Mean dew-point	21.7	....	....
Evaporation (in.):			
Greatest monthly	9.35 (July)	....	....
Total for six months	37.525 (May–Oct.)	....	....
Barometer:			
Highest	23.418 (Sept. 1)	....	....
Lowest	22.501 (Jan. 31)	....	....
Mean	*23.196	....	....
Winds:			
Prevailing direction	SW. and W.	....	....
Greatest velocity (miles per hour)	68 (May 25)	....	....
Miles traveled in year	127,236.8	....	....

	Sheridan.	Sundance.	Wheatland.
Temperature (degrees F.):			
Highest	102 (July 20)	96 (July 22, Aug. 6)	108 (June 18)
Lowest	—45 (Feb. 1)	—31.5 (Jan. 31)	—16 (Jan. 28)
Highest daily range	55 (Oct. 21)	49 (Feb. 4)	55 (Mar 30)
Lowest daily range	0 (Apr. 29, Nov. 17)	2 Feb. 5, Apr. 24, (May 24).	0 (Apr. 17)
Highest annual mean	....	....	48.8
Lowest annual mean	....	....	....
Frosts	May 27, Sept. 23	May 22, Sept. 23	May 19, Sept. 23, 24, 25.

* Record not complete.

The average annual mean temperature for the 6 experiment farms and Bates Park (Freeland) was 42.7° F. The greatest annual precipitation, 19.25 inches, occurred at Bates Park. The average precipitation for the year for places furnishing complete records, as given in the table, was 11.36 inches.

"During the year 1893 the climate has been exceptional in many respects and unfavorable to the growth of crops." September was colder than in previous years, frosts generally appeared earlier, and precipitation was unusually small.

The currents of the Great Lakes, M. W. HARRINGTON (*U. S. Dept. Agr., Weather Bureau Bul. B, Feb., 1894, pp. 6* (*folio*), *maps 6*).—The methods used and the results obtained in a study of the currents of these lakes during the navigation seasons of 1892 and 1893 by means of floating bottles are reported, and a map of each lake is given on which the probable courses of the floating bottles are traced, and from these certain well-defined currents are outlined on a general current chart of all the Great Lakes. The data upon which these charts are based were as

follows: For Lake Superior, 35 bottles recovered in 1892 and 36 in 1893; Lake Michigan, 163 in 1892 and 35 in 1893; Lake Huron, 142 in 1892 and 48 in 1893; Lake Erie, 66 in 1892 and 30 in 1893; and Lake Ontario, 55 in 1892 and 25 in 1893.

Protection from lightning, A. McAdie (*U. S. Dept. Agr., Weather Bureau Circular, April, 1894, pp. 20, pls. 11*).—This is a circular of information, giving "statistics of actual losses, the theory of protection in language free from technicalities, a collection of practical rules for guidance in selecting and maintaining conductors, and, finally, a notable illustration of the successful use of protectors," viz, the Washington Monument at Washington, D. C.

The statistics reported show that in the United States during the 4 years 1890–'93, 784 deaths due to lightning occurred—practically all during the 6 months April to September—the maximum death rate being in June and July. During the 8 years ending with 1892, 3,516 fires due to lightning occurred, involving a loss of $12,663,835. During 9 years ending 1892, 2,335 barns, 104 churches, and 664 dwellings have been struck by lightning.

"One interesting point which appears to be shown by statistical studies of lightning stroke is the decreased liability to accident in thickly settled communities.

"It may be said, in general, that the risk in the country is five times greater than in the city. For ordinary dwelling houses, not unduly exposed in city blocks, lightning rods are hardly necessary, a very considerable protection being afforded by the tin roofing, numerous cornices, gutters, etc. The geological as well as the topographical conditions may have some influence upon the frequency of lightning stroke. According to the authority already quoted,[1] if 1 represents the frequency of lightning stroke in a chalk formation, 2 will represent the liability for marl, 7 for clay, 9 for sand, and 22 for loam.

"With regard to trees, the oak is most frequently and the beech the least frequently struck. The values are something like, if 1 represents the frequency for the beech tree, 15 for pines, other trees generally averaged at 40, and 54 for oaks."

The different kinds of lightning flashes and the function and value of lightning rods are discussed.

"The statement that lightning always follows the path of least resistance, as commonly understood and stated, needs modification. True it is that when the air is strained by being subjected to the electrifications of cloud and earth, the weakest spot gives away first, and this is apt to be in line with some small elevated knob or surface; but it is equally true, and is, perhaps, the more general case, that when a really vigorous disruptive discharge does occur, it is somewhat, as Dr. Lodge aptly puts it, like an 'avalanche.' As a matter of fact, we find from the study of actual cases where buildings have been struck that lightning often disregards entirely metallic surfaces and points. What we should first know is whether the condition is to be one of 'steady strain'[2] or 'impulsive rush'[2] discharge. In the case of 'steady strain" the metal is apt to influence the path of discharge; in the case of an 'impulsive rush" discharge even points seem to lose their efficiency and become of little use. . . .

"While not going into details regarding the question of the shape of the rod, let us emphasize the fact, so recently brought out, that if an electric current flows steadily in one direction in a cylindrical wire its intensity is the same in all por-

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[1] Royal Prussian Bureau of Statistics.

[2] Terms used by Prof. Lodge.

tions of the wire, as shown by Hertz, but that with a current of an oscillatory character, *i. e.*, a current which rapidly reverses its direction, this condition no longer holds, and if the direction is altered very rapidly the interior of the wire—in our case the lightning rod—may be almost free from current."

Specific directions are given regarding the proper construction and maintenance of conductors and other means of protection against lightning, and reference is made to the prevalent misapprehensions "that lightning never strikes twice in the same place; that the most exposed place is always struck; that a few inches of glass or a few feet of air will serve as a competent insulator to bar the progress of a flash that has forced its way through a thousand feet of air," etc.

Prompt and unremitting efforts to restore consciousness in persons struck by lightning are urged. "There is reason for believing that lightning often brings about suspended animation rather than somatic death. . . . No records sufficiently extended and authentic are available to ascertain what proportion of persons struck by lightning are killed outright. I know of but one record, and in that of 212 persons struck 74 were killed."

Meteorological observations (*Arkansas Sta. Rpt. 1893, pp. 143, 144*).—A tabulated summary of observations on temperature, rainfall, and cloudiness from May to October, 1891, at Fayetteville, Ark.

Meteorology for 1892, R. D. NEWTON (*New York State Sta. Rpt. 1892, pp. 701–716*).—Tables are given which show the monthly precipitation since 1882; a daily record of direction and movement of wind during each month of 1892; a daily sunshine record for 1892, and a monthly summary of the sunshine record May 1, 1885, to January 1, 1893; and daily readings of maximum, minimum, and standard thermometers for each month of the year 1892.

Meteorological summary for North Carolina for March, 1894, H. B. BATTLE, C. F. VON HERMANN, and R. NUNN (*North Carolina Sta. Met. Bul. 54, pp. 39–52, maps 2*).—Notes on the weather and detailed summaries of observations by the State weather service coöperating with the Weather Bureau of this Department.

SOILS.

Conservation of moisture in the soil, S. B. GREEN (*Minnesota Sta. Bul. 32, pp. 232–238*).

Synopsis.—Means of reducing the loss of soil moisture by evaporation are discussed. Wind-breaks are valuable for this purpose, but mulching is shown to be especially effective by the results of experiments and observations at the station.

The three ways in which water which reaches the soil is dissipated—surface drainage, underground drainage, and evaporation—are briefly discussed, and means of lessening the loss of water from evaporation are explained. The means suggested are wind-breaks, mulching, and cultivation. The advantages of wind-breaks are deduced largely from theoretical considerations, but results of quite extensive experience with mulches on trees, shrubs, small fruits, and grapes on the station farm are reported. The water content of soil and subsoil of mulched,

cultivated, and uncultivated lands at different dates, as determined by H. Snyder, are also reported.

The results of these observations and experiments are summarized as follows:

"(1) The water-holding and consequently drought-resisting qualities of the soil are increased by the addition of organic matter to the soil.

"(2) The loss of water by evaporation from the surface of the soil must be regarded as the prime factor in robbing the soil of its moisture.

"(3) Anything that breaks the force of the wind may make the difference between success and failure in growing crops by lessening the evaporation.

"(4) Evaporation from the soil may be largely prevented by the use of a mulch on the surface.

"(5) The use of a mulch may sometimes increase the amount of water in the upper 1 foot of soil on 1 acre by 1,700 bbls., and it probably exerts as much influence on the several upper feet of soil. As the roots of corn and most other vigorous plants penetrate several feet into the soil, the increase due to a covering of mulch must be considerable.

"(6) It will be found that a circular plat of land 6 feet in diameter that is mulched may have the water it contains increased in a period of drought by 8 gallons in the upper 2 feet of soil. This indicates the great value of a mulch around street trees.

"(7) The use of a mulch on many garden crops will often make the difference between success and failure."

Investigations on nitrification, E. GODLEWSKI (*Anzieg. Akad. Krakau, Dec., 1892; abs. in Centbl. agr. Chem., 22 (1893), No. 12, pp. 848–851, and in Jour. Assoc. Anc. Élèv. Gembloux, 4 (1894), No. 8, pp. 269, 270*).—Experiments to determine whether the organisms of fermentation derive their carbon from mineral substances, as claimed by Winogradsky, or are dependent upon the volatile organic substances of the air absorbed by the nutrient solution, as suggested by Elfving, are reported in detail. The conclusions reached are that—

(1) It is very improbable that the nitromonas derive their carbon from the organic substances of the air.

(2) Nitromonas placed in a pure mineral solution are not able to assimilate the carbon of magnesium carbonate.

(3) It is very probable that these organisms find the carbon which they need in the free carbonic acid or in the carbonic acid of bicarbonates.

These investigations also confirm the opinion widely entertained that free nitrogen is formed during nitrification.

The author suggests that the nitromonas find in the oxidation of ammonia a source of energy sufficient to enable them to accomplish the dissociation of carbonic acid.

Methods of soil analysis, F. H. WERENSKIOLD (*Rpt. Chem. Control Sta. Christiania, 1893, pp. 29, 30*).—The solution is prepared by digesting 150 gm. of fine soil with 500 cc. of 10 per cent HCl in the cold for 48 hours with frequent shaking (carbonates that may be present are previously saturated with HCl). The solution is filtered through a dry filter.

Determination of lime.—Lime is determined in the filtrate in the following manner: 50 cc. (corresponding to 15 gm. of soil) are boiled in a

100 cc. flask with a little $KClO_3$, nearly neutralized with ammonia, and then boiled with sodium acetate, which will precipitate the greater portion of the iron, silica, and phosphoric acid. The solution is cooled rapidly, made up to 100 cc., and passed through a dry filter; 50 cc. (corresponding to 7.5 gm. of the original sample) is strongly acidified with acetic acid and the lime is precipitated by ammonium oxalate with heating. The precipitate is washed, dried, ignited in a platinum crucible over a blast lamp for about 10 minutes, dissolved in a measured quantity of dilute HCl of known strength, and titrated with a baryta solution. The solution must be previously filtered if turbid or colored from undissolved oxide of iron or manganese.

Determination of potash and phosphoric acid.—One hundred cubic centimeters of the filtrate is measured into a 200 cc. flask and oxidized with 25 to 30 cc. of a saturated bromin solution (the oxidation is often incomplete). The solution is then boiled until the bromin is driven off, precipitated with ammonia and carbonate and oxalate of ammonia, cooled, filled to mark, and filtered. Fifty cubic centimeters of the filtrate is evaporated to dryness, first on a water bath, then in an air bath; the ammonia salts are carefully volatilized and about 1 cc. of a saturated oxalic acid solution is added to the residue, again evaporated, and carefully ignited. Organic matter is destroyed by this method, and salts of heavy metals changed into carbonates. The alkalies are then dissolved in boiling water, a little HCl added, and the potash determined in the usual manner.

The precipitate formed by the addition of ammonia and carbonate and oxalate of ammonia is transferred to a filter, washed with a little boiling water to remove the greater portion of the ammonia salts, boiled with concentrated H_2SO_4 (silica precipitated), made up to 100 cc. in a graduated flask and filtered. The phosphoric acid is determined in the usual way in 500 cc. of the filtrate (corresponding to 15 gm. of the sample).—F. W. WOLL.

Soil temperatures, R. D. NEWTON (*New York State Sta. Rpt. 1892, pp. 717–723*).—A tabulated record for 1892 of tri-daily readings of soil thermometers at depths of from 1 to 18 in. is given.

Soil temperatures, B. C. BUFFUM (*Wyoming Sta. Bul. 17, p. 42*).—A table shows the weekly means of observations at depths of from 3 to 72 in. at Laramie, Wyo., during the year 1893.

Researches on the behavior of soils toward water, A. PEIFFER (*Rev. Agron., 3 (1894), No. 1, pp. 9–14*).—A brief résumé of the work of Wollny on the absorption, percolation, and evaporation of soil water; of A. Müller on the effect of frost; and of R. Sachsse, A. Becker, and T. Schlösing on the effect of the flocculation of clay by lime on the movement of soil water.

A preliminary examination of certain soils of the arrondissement of Béziers, H. LAGATU and L. SEMICHON.—A 65-page pamphlet reporting results of mechanical and chemical analyses, with description of samples of 44 samples of soils with corresponding subsoils made at the National School of Agriculture of Montpellier.

Agricultural charts of the canton of Ferté-sous-Jouarre, GATELLIER (*Compt. Rend., 118 (1894), No. 21, pp. 1167–1170*).—A brief discussion of the practical value of this chart, which is based upon a careful agricultural survey and shows the area and

geological origin of the soils of this locality, their chemical and physical character, and the fertilizers needed.

Concerning nitrification, G. TOLOMEI (*Staz. Sper. Agr. Ital., 26 (1894), No. 3, pp. 246–263*).—A review of the subject and a record of the author's experiments and observations on the conditions under which nitrification occurs.

On the utilization of marshes, U. SVERDRUP (*Tidskr. norske Landbr., 1 (1894), pp. 125–170*).

The valuation of arable soils on a scientific statistical basis, G. THOMS (*Jour. Landw., 42 (1894), No. 1, pp. 1–31, fig. 1, dgm. 1*).—This is substantially a reprint of an article published in *Mitt. kaiserl. livländ. gemcinütz ökon. Soc., 1893, No. 13*, and already abstracted (E. S. R., 5, p. 418).

FERTILIZERS.

Leather refuse, its value in agriculture, J. B. LINDSEY (*Agricultural Science, 8 (1894), No. 2, pp. 49–61; No. 3, pp. 98–108*).—The author reviews methods which have been employed to render the nitrogen of leather available to growing plants; pot, plat, and field experiments with leather waste as a fertilizer for different crops; and work on artificial digestion and nitrification of leather. He then reports the results of experiments by himself on the method (proposed by Dabney) of detecting leather in fertilizers by means of a phosphoric acid solution of phosphate of iron; on the digestibility in pepsin and pancreas solutions of raw leather and leather which had been heated with water in a pressure bottle at 110° C. for 6 hours, as compared with that of tankage and dried blood; and in treating leather with different amounts and strengths of sulphuric acid and drying with bone ash or floats, tests being made in the resulting product for tannic acid.

"The results of the combined experiments in the field and in pots, together with artificial digestion experiments and nitrification experiments, indicate that leather, either raw, roasted, or steamed, is a very slow acting form of nitrogen as a source of plant food. . . . Carefully conducted experiments by Wagner give it a relative value of 20, nitrate of soda being equal to 100. From the mass of evidence at our command it would seem that this figure about expresses its relative worth as a direct source of plant food. . . .

"Artificial digestion experiments show that the nitrogen in either untreated, steamed, or roasted leather after being acted upon by sulphuric acid has a digestibility of 70 per cent. If pot and field experiments corroborate the digestion experiments, it would make plain that the nitrogen in leather after being thus treated would be as available as a source of plant food as the nitrogen in the average fish, blood, etc.

"Whether it would be practicable from an economical standpoint to thus utilize the leather waste is of course another question which must be answered by practical experiments. . . .

"The various experiments made would indicate that leather, sulphuric acid, water, and floats should be mixed in about the following relative proportions:

2,000 lbs. 50° B. sulphuric acid.
600 lbs. ground leather.
800 lbs. water.
2,700 lbs. floats.

"The resulting mixture, when in fairly dry condition, would weigh approximately 5,000 lbs., shrinking about 18 to 20 per cent. It would have approximately the following composition:

	Per cent.
Moisture	18.00
Available phosphoric acid	8.50
Insoluble phosphoric acid	2.00
Total phosporic acid	10.50
Total nitrogen	0.90

"Two thousand pounds of sulphuric acid will not take up more than 600 lbs. of leather and render the leather 70 per cent digestible."

Coöperative fertilizer experiments in Norway in 1892, F. H. WERENSKIOLD (*Norsk Landmandsblad, 13 (1894), pp. 97–99*).—The experiments were conducted under the auspices of the Smålenene County Agricultural Society, and the analytical work was done by the Chemical Control Station at Christiania. Seven farmers reported results during 1892. Barley was in all cases grown on 3 experimental plats. Of these, plats 1 and 2 received Thomas slag phosphate and superphosphate, respectively, while plat 3 received no phosphoric acid. The quantities of fertilizers applied and size of plats are not given in the report. The average composition of the ash of the grain and straw produced was as follows:

Composition of ash of grain and straw from differently treated plats.

	Grain.			Straw.		
	Nitrogen.	Phosphoric acid.	Potash.	Nitrogen.	Phosphoric acid.	Potash.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Plat 1, Thomas slag	1.72	0.98	0.63	0.45	0.22	1.59
Plat 2, superphosphate	1.69	0.92	0.60	0.48	0.22	1.51
Plat 3, no phosphate	1.80	0.92	0.58	0.60	0.23	1.47

The following average yield of grain and straw were obtained:

Average yields of grain and straw.

	Grain.	Straw.
	Kg.	*Kg.*
Plat 1	83.7	144.1
Plat 2	79.7	138.6
Plat 3	63.1	114.2

The average increase in yield per ar (= one fourth acre) with fertilizers on plats 1 and 2 over plat 3 was 61.8 kg. of grain and 89.7 of straw with Thomas slag phosphate, and 49.8 kg. of grain and 73.2 of straw with superphosphate.—F. W. WOLL.

Commercial fertilizers, P. COLLIER and L. L. VAN SLYKE (*New York State Sta. Rpt. 1892, pp. 209–221, 495–529*).—Remarks on the conduct of the fertilizer control, the text of the State fertilizer law, a schedule of trade values for 1892 and 1893 and notes on valuation, statistics of the fertilizer trade in New York, and tabulated analyses of 247 brands of fertilizers examined during the year.

Of the 247 brands analyzed 32 were accompanied by guaranties of definite amounts of each of the fertilizing constituents, while in case of 215 brands the maximum and minimum amounts were guaranteed.

"In the 32 samples in which a definite amount of each constituent was guaranteed the average quantity guaranteed and found was as follows:

Constituents guaranteed and found in commercial fertilizers.

	Nitrogen.	Available phosphoric acid.	Potash.
	Per cent.	*Per cent.*	*Per cent.*
Guaranteed	2.785	8.638	5.040
Found	3.171	9.450	5.373

"Or an excess of 13.9 per cent of nitrogen, of 9.4 of available phosphoric acid, and of 6.7 of potash over the guaranteed amount. . . .

"Of the 215 samples where minimum and maximum amounts were given as guaranteed, the average results are as follows:

Minimum and maximum constituents guaranteed and amount found in commercial fertilizers.

	Nitrogen.	Available phosphoric acid.	Potash.
	Per cent.	*Per cent.*	*Per cent.*
Minimum guaranteed	1.984	8.446	3.044
Maximum guaranteed	2.960	10.600	3.980
Found	2.251	9.339	3.371

"Or an excess of 13.4 per cent of nitrogen, of 10.6 of available phosphoric acid, and of 10.7 of potash over the minimum amount guaranteed; while the maximum amounts guaranteed were 19.6 per cent of nitrogen, 13.5 of available phosphoric acid, and 18 of potash greater than the actual amounts of each of these constituents found to be present."

Replies to circulars of inquiry sent out during 1891 and 1892 to fertilizer manufacturers doing business in the State show the aggregate sales in the State in 1892 to have been 92,020 tons.

Fertilizer inspection and analysis in Vermont, J. L. HILLS and B. O. WHITE (*Vermont Sta. Bul. 41, pp. 16*).—This includes the schedule of trade values of fertilizing ingredients for 1893 and 1894; notes on valuation; tabulated analyses and valuations of 79 samples of fertilizing materials, including various factory-mixed fertilizers, wood ashes, muck, and tankage; a comparison of the values of fertilizers licensed in 1893 and 1894, and a review of 10 years of fertilizer inspection in Vermont.

"The comparison of the average composition of the fertilizers sold in the State this year with those of the past 10 years shows that the 1894 goods are of poorer quality than any sold during this time. The average selling price is lower than ever before, being 85 cts. less than last year, but the average valuation is $1.62 less than in 1893, based on the same (1894) trade values.

"Since 1885 over 90 different brands of fertilizers have been sold in Vermont. Selling prices have dropped 17 per cent and valuations 20. The percentage of cost over valuation was least in 1889 and is most now. Owing to the lower prices of nitro-

gen and phosphoric acid the buyer does not pay as much now for plant food as 10 years ago, yet he pays more than at any time during the past 6 years."

Experiments in green manuring at Alnarp (Sweden), 1893 (*Tidskr. Landtmän, 15 (1894), pp. 245, 246*).

Green manuring vs. stable manure, P. WAGNER (*Braunschw. landw. Ztg., 62 (1894), No. 20, pp. 89, 90; No. 21, pp. 93, 94.*)—A controversial article on the value of the nitrogen in chemical fertilizers, in green manures, and in stable manure.

The use and value of poudrette, J. H. VOGEL (*Deut. landw. Presse, 21 (1894), No. 44, pp. 434, 435.*)—A popular paper on the fertilizing value of poudrette and the conditions under which its use is advantageous.

The value of peat for cleaning and disinfection, L. F. NILSON (*Tidskr. Landtmän, 15 (1894), pp. 311–315, 329–333, 347–351*).

Phosphoric acid from different sources, MAERCKER (*Westpreuss. landw. Mitt.; abs. in Fühling's landw. Ztg., 43 (1894), No. 10, pp. 317–321*).—The agricultural value of phosphoric acid in Thomas slag, superphosphate, bone meal, prepared phosphate meal, and floats, as determined by experiments.

Phosphatic fertilizers, MAIZIÉRES (*L'Engrais, 9 (1894), No. 21, pp. 492, 493*).

Determination of the value of commercial potash, O. BERNHEIMER (*Chem. Ztg., 18 (1894), No. 40, pp. 742, 743*).

Potash and soda for crops, P. COLLIER (*Cultivator and Country Gentleman, 1894, May 31*).

Potash and soda, W. F. MASSEY (*Southern Planter, 1894, June*).

Contributions from Alnarp laboratory (Sweden): I, fertilizers and amendments (*Tidskr. Landtmän, 15 (1894), pp. 227–232*).

Fertilizer inspection and analysis in North Carolina, H. B. BATTLE (*North Carolina Sta. Special Bul. 21, pp. 2*).—Tabulated analyses and valuations of 15 brands of fertilizers.

Commercial fertilizers, H. A. HUSTON (*Special Bul. Purdue University, May, 1894, pp. 11*).—Statistics are given of the fertilizer trade in Indiana in 1893, with comments on changes in the character of the fertilizers sold in the State, data relating to amount of plant food removed from the soil in different farm crops, illustrations of the returns that can be secured from the use of fertilizers, notes on valuation and on the conduct of the State fertilizer control, and tabulated analyses of 247 brands of fertilizers legally on sale in Indiana, May, 1894.

FIELD CROPS.

The culture of barley for malting purposes, H. SCHJERNING (*Ugeskr. Landmänd, 39 (1894), pp. 146, 147*).—The author, who is director of the Vy Carlsberg chemical laboratory at Copenhagen, takes issue with Sonne in his conclusions drawn from the culture experiments with barley conducted by the Danish Agricultural Society (E. S. R., 5, p. 716). Looking at the question from the brewer's standpoint, he says there are only two factors to be considered in judging the malting properties of a sample of barley, viz, its purity and its power of germination. Under the former, color is to be noted, but is not of prime importance. By far the most important factor for the malting is the germination. If this is perfect the first condition of a good product and a good yield is at hand.

The total nitrogen content and the mealiness can not, on the other hand, be deemed of importance in considering this question. The nitrogen in barley is present in various organic combinations of dif-

ferent properties, the relative proportions of which are almost unknown to us. It is more a question of the composition of the nitrogenous compounds than of the quantities of these present. In 14 samples of malt it was found that from 28 to 40 per cent of the total nitrogen of the barley went into the wort. The nitrogen content of the latter depends less on the quantity of nitrogen in the barley than on the process of malting practiced.

The yield of extract decreases as the nitrogen content of the barley increases, viz, about 2 per cent for every 3 per cent of protein contained in the barley. The author states that this has an influence only on the market value of the barley and not on its value for malting purposes. He considers the mealiness of the barley of no importance in judging its malting value, and quotes Prof. Grönlund (*Tidsskr. Landökon., 1882, p. 654*), whose investigations show that even a very hard barley may be changed almost entirely to a soft barley during the germination by the action of water for an extended period. These results were confirmed by Nielsen (*Ugeskr. Landmänd, 1883*).—F. W. WOLL.

Experiments with different phosphates on red clover, R. VON LIEBENBERG (*Mitt. Ver. Förd. landw. Versuchs. Oesterr., 1893, No. 8, pt. II, pp. 151–153*).—It is generally accepted as a fact that leguminous plants respond to applications of phosphoric acid and potash, but do not require applications of nitrogen, and it is a common practice to depend upon the excess of phosphoric acid in the fertilizer applied to the cereal crop in which clover is usually sown to supply the following crop of clover with this element.

The observation of the author that manuring of cereals with phosphoric acid and potash on the soils used often proved unprofitable, and doubt as to the extent of the after action of phosphoric acid applied to previous crops, led to the institution of experiments to determine whether direct manuring of clover with phosphoric acid is economical and whether the cheaper insoluble phosphates might not be substituted for the expensive superphosphates for this purpose. Ground Thomas slag, steamed bone meal, Redonda phosphate, bone ash, and spodium superphosphate were applied November 5 at rates of 60 and 120 kg. per hectare to clover seeded in rye on triplicate plats (containing 160 sq. m.) of soil of known composition, 4 plats remaining unmanured.

The tabulated yields of hay at 2 cuttings show that spodium superphosphate was the only manure which increased the yield, and that the use of this fertilizer was profitable. The plats receiving the crude phosphates actually gave a lower yield than those receiving no fertilizer.

The results with the superphosphate seemed to be due to the more complete diffusion of the phosphoric acid of this material in the soil. With the crude phosphates, on the other hand, the small amount of phosphoric acid which became available remained in the surface layer of the soil and was exhausted by the clover in its earlier stages of growth, but when the plant developed and its roots spread out in the lower layers of the soil it suffered from a deficiency of phosphoric acid.

Another point of special interest observed in these experiments was that applications of phosphoric acid were beneficial to clover on soil which was not actually poor in phosphoric acid and on which cereals do not generally respond to applications of this element of plant food.

Field experiments with corn, 1893, G. E. MORROW and F. D. GARDNER (*Illinois Sta. Bul. 31, pp. 333–360*).

Synopsis.—Accounts are given of experiments in the following lines: (1) Test of varieties, (2) time of planting, (3) depth of planting, (4) thickness of planting, (5) planting in hills and drills, (6) frequency and depth of cultivation, (7) root-pruning, (8) continuous cropping *vs.* a rotation of crops, (9) time of harvesting, and (10) cross fertilization. The results of these and previous experiments at the station favor (1) medium maturing varieties with ears above the average in size, (2) planting from May 10 to 15, (3) shallow planting, (4) planting from about 12,000 to 24,000 kernels per acre, (5) either hills or drills, (6) only enough cultivation to keep the soil free from weeds and surface well stirred, (7) the avoidance of root-pruning, (8) rotation of crops, (9) late harvesting, and (10) cross breeding to increase yield.

The experiments in 1893 were in continuation of those reported in Bulletin 25 of the station (E. S. R., 4, p. 409). As in previous years, the experiments were conducted on dark-colored, fertile prairie soil about 18 in. deep, with a yellow clay subsoil. As a rule, there were 4 plants in hills 3⅔ feet apart each way. For the 3 months beginning June 11 the rainfall was only 0.94 in. The temperature during all the growing season was somewhat below the average.

Varieties (pp. 337–351).—The test of varieties occupied 119 plats. The results are given as heretofore in detail in tables, summaries, and general notes. Mixtures of 2 and 4 varieties in 4 out of 5 cases gave larger yields than the single varieties, a result directly opposed to that secured in 1892. "No variety has been shown to be greatly superior to the others, nor has it been shown that the yield depends upon either the color of the kernel or on the exact shape of either the ear or kernel."

Time of planting (pp. 351–353).—Burr White was planted at intervals of a week from May 6 to June 17. The largest yield was from planting May 13, closely followed by the planting of May 6. "Taking the average of 6 years, the largest yield was from planting May 11 to 16, with but little decrease in yield from planting anytime from April 27 to May 23."

Depth of planting (p. 353).—The results of planting corn at depths of from 1 to 7 in. during 5 years are tabulated. The yields decreased as the depth of planting increased.

Thickness of planting (pp. 353–355).—Tabulated data are given for experiments, in which from 1 to 4 kernels were planted in hills from 3 to 60 in. apart. "The result of all trials at the station clearly indicates that in average seasons, in central Illinois at least, a lessened yield may be expected if the number of stalks is less than 3 in a hill."

Hills vs. drills (p. 355).—Notes and tabulated data are given for an experiment occupying 10 plats. "In no year out of the 6 was any material difference shown in the yield of corn, whether planted in hills or drills, where equal numbers of kernels were planted."

Frequency and depth of cultivation (pp. 355, 356).—Ordinary and frequent cultivation at different depths were compared with mere removal of the weeds on 11 plats. Taking the average of 5 years, shallow cultivation produced 5.9 bus. per acre more than deep, and scraping the surface 2.7 bus. more than deep cultivation.

Root-pruning (p. 357).—In 1893 alternate rows of corn were root-pruned and yielded 78.8 bus. per acre; the rows not root-pruned yielded 100.3 bus. per acre.

Continuous corn cropping contrasted with rotation of crops (pp. 357, 358).—Tabulated data give the results secured during the last 6 years on half-acre plats which had been under test for 18 years. On 3 plats corn was grown continuously, and on 1 corn and oats, without manure, alternated. On 6 unfertilized plats corn was grown for 2 successive years in a 6 years' rotation, consisting of corn, oats, and clover. On 1 of the plats, continuously in corn, barnyard manure was applied annually at the rate of 24 two-horse wagon loads per acre; on another plat different commercial fertilizers were used, and still another was unfertilized. As the average of the yields for the last 6 years the plats manured with barnyard manure yielded more than the rotation plats without manure; but in the dry seasons of 1887 and 1893 the rotation plats yielded more than the plat with barnyard manure. "The yields from the plat to which no fertilizers were applied have practically equaled those from that to which commercial manures have been applied; but they fell far short of those from the rotation plats, and seemed below those from the plat on which the corn was grown in rotation with oats."

Time of harvesting (pp. 358, 359).—Corn cut early with the ears mostly in the roasting-ear stage and the husks and leaves green yielded 2,521 lbs. of corn per acre; harvested when most of the ears were glazed and when a few husks and leaves were becoming dry the yield was 3,232 lbs. Late harvesting when the corn was fully ripe resulted in a yield of 3,874 lbs. Both early and late harvesting gave a larger yield of stover than harvesting at an intermediate date.

Cross fertilization (pp. 359, 360).—Three plats were planted with corn from self-fertilized ears and 3 others with corn resulting from cross fertilization between different stalks of the same variety. "In every instance the cross-fertilized ear produced the largest yield and the stalks were visibly larger," but the self-fertilized ears were more uniform in character.

Four plats were planted with four cross-bred ears each, the result of crossing 2 varieties. In 3 out of four cases the yield from the cross was greater than the average yield of the parent varieties, the average difference being 2.3 bus. per acre in favor of the crosses.

Rate of growth and chemical composition of the corn plant, E. H. FARRINGTON (*Illinois Sta. Bul. 31, pp. 361–381*).

Synopsis.—Tabulated data giving the height of plants, weight of dry matter, and meteorological conditions for each week of the growing season for the years 1889, 1890, 1891, and 1892. The composition of the green plant for each week of the growing season of 1892 is given in tables and general notes. The data show that the increase in dry matter continued about 4 weeks after the plant had reached its maximum height. An experiment in germinating corn seeds showed that the loss of dry matter during germination was considerable.

In these experiments the following varieties of corn were used: In 1889, Edmunds, planted May 4; in 1890, Burr White, planted May 5; in 1891, Leaming, planted May 9; in 1892, Burr White, planted June 3. From 6 to 226 stalks were measured each week, and 3 samples, each consisting of 3 plants, were analyzed weekly. The average percentage of the total height and dry matter made each week after the time when the plants were 1 foot high was as follows, the figures being the average results for 4 years:

Percentage of growth in height and increase in dry matter, 1889–'92.

Week.	Growth in height.	Increase in dry matter.	Week.	Growth in height.	Increase in dry matter.
	Per cent.	*Per cent.*		*Per cent.*	*Per cent.*
First	11.6	....	Eighth	8.2	10
Second	8.3	0.6	Ninth	....	11.2
Third	11.3	2	Tenth	....	4.3
Fourth	14	3.2	Eleventh	....	11
Fifth	20.3	6.2	Twelfth	....	7
Sixth	12	13.5	Thirteenth	....	8.4
Seventh	12.7	10.3	Fourteenth	....	8.6

The proportionate growth for corresponding weeks in 1889, 1890, and 1891 was quite uniform. In 1892, when the corn was planted late, a greater percentage of the growth was made later in the season than in the other years.

"The higher the temperature the better the corn growth, and according to the observations made heat seemed to be more beneficial than rain. The most rapid growth in height was made when the corn was between 3 and 6 ft. tall. It grew 2 ft. per week for 2 weeks in succession the last of June, 1890. The excessive rain of April, May, and June, 1892, prevented the same growth of corn as in the previous years during these months, but about 3 in. in height per day was made in the last week in July, 1892. The table shows that in the first 3 years the corn reached its maximum height 8 weeks after it was 1 ft. high, but in 1892 it kept on increasing in height for 10 weeks from this time.

"No uniform relation between growth of plant and meteorological conditions can be exactly traced from these figures, which cover a period of 4 years of observations."

In 1892, when the corn was planted about a month later than usual, the green corn plants were analyzed each week. The figures show that the plants attained their maximum height August 19, their greatest weight of water August 26, and their greatest weight of dry matter September 16.

"When a corn plant has reached its total growth in height it has attained only one half the weight of dry substance it will gain if left to grow to maturity. . .

"[One hundred pounds of] young corn plants 2 ft. high contained as much protein and ash as the same quantity of fully mature corn, although the young corn plant has 90 and the ripe plant only 60 per cent of water. This does not hold true of the other constituents, however. The fiber, starch, etc., in 100 lbs. of the ripe plant is nearly 10 times that in the young corn. The relation between the nitrogenous (protein) and carbonaceous (fiber, starch, etc.) constituents is as 1 to 3 in the young plant and as 1 to 13 in the ripe corn plant in September and October.

"One hundred lbs. corn 2 ft. high contained 1.8 lbs. ash, 2.8 lbs. nitrogenous matter, 6.2 lbs. carbonaceous, and 89.2 lbs. water.

"One hundred lbs. ripe corn 9 ft. high contained 1.8 lbs. ash, 2.8 lbs. nitrogenous matter, 35.4 lbs. carbonaceous, and 60 lbs. water."

When planted in the first half of May 4½ months were required for the corn plant to reach its maximum weight of dry substance; when planted later the requisite time was less.

Corn kernels were sprouted in moist cotton, and when the root and stem each measured 2 to 3 in. the plants were analyzed. About one fourth of the dry matter of the kernel was lost in germination. Corn kernels were sprouted in the ground, and when the plants were from 1 to 4 in. high with roots about 5 in. long they were analyzed, and then contained from 58 to 79 per cent of the original dry matter of the kernels. Corn plants 10 to 12 in. high were analyzed about 10 days after the seed was planted. In some of these plants the dry matter was less than that in the kernel planted.

Experiments with corn, C. C. GEORGESON, F. C. BURTIS, and D. H. OTIS (*Kansas Sta. Bul. 45, pp. 129–149*).

Synopsis.—Experiments on (1) frequency of cultivation, (2) detasseling, (3) different distances between rows and in the drill, (4) butt, middle, and tip kernels as seed, (5) methods of planting and cultivating, and (6) varieties. The results for 1893 favor (1) cultivating once a week, (2) not detasseling, (3) planting every 16 in. in rows 4 ft. apart, (4) planting kernels from the tip of the ear, (3) listing and deep cultivation, closely followed by surface planting and shallow culture. Forty-eight varieties were tested.

Frequency of cultivation (pp. 129–131).—This experiment occupied 30 plats. The following table gives the average results for three years:

Frequency of cultivation.

	Times cultivated during season of 1891.	Times cultivated during season of 1892.	Times cultivated during season of 1893.	Average yield per acre.
				Bushels.
Twice a week	9	11	14	40.31
Once a week	6	6	7	41.29
Once in 2 weeks	4	3	4	40.86

The table shows that the best results were secured by cultivating corn once a week.

Detasseling (pp. 132–138).—On 2 plats the tassels were removed from alternate rows. On 2 plats all the tassels which first appeared were pulled, those developing later being left entire. On 2 plats the tassels

were removed from alternate stalks in each row. Two plats were not detasseled. The variety used was Piasa Queen, a medium early yellow corn planted at distances of 16 in. by 3½ ft. On the plats from which the tassels were removed on alternate rows the detasseled rows yielded 114.55 lbs. of corn, the rows with tassels entire 185.75 lbs. Where only the first tassels were removed the yield per plat was 329.57 lbs. On the plats from which the tassels were removed from alternate stalks the detasseled stalks yielded 71.77 lbs., and the stalks not detasseled 151.61 lbs. On the plats not detasseled the yield per plat was 357.30 lbs. "Owing to the unfavorable weather at the critical period in the growth of the crop there was scarcely pollen enough produced to fertilize the ears, even had all the tassels remained, and removing them made the evil worse." These results are opposed to those secured in 1892, when a gain resulted from detasseling.

Distance (pp. 138–142).—An experiment to determine the best distance between rows and between plants in the drill occupied 70 plats. The largest yield of marketable corn resulted from planting at distances of 16 in. by 4 ft.

Seed corn from different parts of the ear (pp. 143, 144).—This experiment in which "Dole ninety-day corn" was used occupied 15 plats. In 1893, contrary to former results, the kernels from the tip of the ear gave the largest yield of corn. The following table gives the average yield of corn for 3 years resulting from planting the kernels from the butt, tip, and middle of the ear:

Averages of 3 years' trials of seed corn from butt, tip, and middle of ear.

Nature of seed.	Good ears per acre.	Nubbins per acre.	Total yield per acre.
	Bushels.	*Bushels.*	*Bushels.*
Butt kernels	28.04	13.44	41.48
Middle kernels	26.36	12.31	38.67
Tip kernels	27.19	13.04	40.23

Methods of planting and cultivating (pp. 144–146).—This experiment occupied 30 plats, and embraced (1) listing *vs.* surface planting and (2) deep, shallow, and surface culture, and combined deep and shallow culture. The variety was Farmer Favorite. For deep culture the two-horse cultivator with 4 shovels was used, and for shallow culture the Daisy spring-tooth cultivator with 8 small shovels. For surface culture the plats were simply scraped with the Tower cultivator. Combined deep and shallow culture consisted of deep culture for the first and last cultivation and shallow culture for all others. The differences between the yields resulting from different methods of planting and of cultivation were slight. The largest yield in 1893 was secured on the listed plats cultivated deep. The largest average yield for 2 years was from the surface-planted plats cultivated shallow.

Varieties (pp. 146–149).—The date of tasseling and ripening, height of stalk, height of ear from ground, and yield of sound corn and nubbins are given in tables for each of 48 varieties. The largest yield of sound corn, 24.28 bus. per acre, was made by Stewart Improved.

Experiments with corn, A. C. MAGRUDER (*Oklahoma Sta. Bul. 10, pp. 39–46*).—Experiments with varieties, distance, number of stalks per hill, frequency and depth of cultivation, listing *vs.* drilling, and subsoiling on alkali soil.

Forty-two plats were used for a test of varieties and seed was obtained from 13 States. The largest yield, 840 lbs. of ear corn per acre, was made by Champion White Pearl, from Kansas. Eleven varieties from the Southern States averaged 262 lbs. of corn and 1,323 lbs. of stover per acre; 23 varieties from States north of Oklahoma yielded 514 lbs. of corn and 1,203.7 lbs. of stover per acre. Listed corn covered 6 in. deep yielded 15.2 bus.; drilled corn planted 3 in. deep yielded 9.6 bus. per acre.

Shallow cultivation resulted in a smaller yield than deep cultivation for drilled corn, but in a larger yield for listed corn. Drilled corn made the largest yield when cultivated deep 5 times; listed corn when cultivated shallow 10 times. Subsoiling alkali lands was unprofitable.

Corn as a silage crop, W. H. JORDAN (*Maine Sta. Bul. 11, 2d ser., pp. 4*).—A brief statement of the results of an experiment in comparing Southern corn with Maine field corn for silage. In 1888, 1890, and 1891 Southern corn gave a larger yield of digestible dry matter per acre. In 1892 and 1893 Maine field corn gave a larger yield of digestible dry matter. The average results for 5 years were as follows: Southern corn yielded 34,761 lbs. of green fodder per acre, Maine field corn 22,260 lbs. The dry matter in Southern corn was 14.5 per cent; in Maine field corn 18.75 per cent, or as 100:129. In Southern corn 65 per cent of the total dry matter was digestible; in Maine field corn 73 per cent, or as 100:112. In 100 lbs. of dry matter there was in Southern corn 7.28 lbs. of digestible dry matter; in Maine field corn 13.69 lbs., or as 100:189. Southern corn averaged 3,251 lbs. of digestible dry matter per acre, and Maine field corn 3,076 lbs.

"The yield of digestible dry matter has averaged 175 lbs. more with the Southern corn. To offset this it has been necessary to handle annually 5.75 tons more weight.

"The largest as well as the smallest yield of digestible matter in a single year has come from the Maine field corn."

Some leguminous plants, G. MCCARTHY and F. E. EMERY (*North Carolina Sta. Bul. 98, pp. 135–150, 157–170*).—Directions for the culture of various leguminous plants, and notes on the growth made by the following species and varieties, most of which were grown on lowland and upland at the station: Alfalfa (*Medicago sativa*), hybrid medic, or sand lucern (*M. media*), black medic (*M. lupulina*), sainfoin (*Onobrychis sativa*), sulla (*Hedysarum coronarium*), serradella (*Ornithopus sativus*), kidney vetch (*Anthyllis vulneraria*), Japan clover (*Les-

pedeza striata), "hagy" (*L. bicolor intermedia*), beggar weed (*Desmodium molle*), yellow lupine (*Lupinis luteus*), common vetch (*Vicia sativa*), hairy vetch (*V. villosa*), *Lathyrus hirsutus*, flat pea (*L. sylvestris*), false, or bastard, vetch (*Phaca bœtica*), goober pea (*Voandzee subterranea*), alsike clover (*Trifolium hybridum*), common white clover (*T. repens*), giant broad-leaved white clover (*T. repens latus*), red clover (*T. pratense*,) mammoth, or peavine, clover (*T. pratense perenne*), zigzag clover (*T. medium*), crimson clover (*T. incarnatum*), Unknown, or Wonderful, Whippoorwill, Black, Stewart, Lady, Conch, Red Ripper, Capehart Red, and Speckled varieties of cowpeas, several varieties of soja beans (*Glycine hispida*), and several varieties of Japanese beans (*Phaseolus radiatus*).

On stiff red clay soil hybrid medic proved less delicate than alfalfa. Black medic "shows rather less promise than Japan clover, but is more hardy and can be used where the other does not stand the winter." Sainfoin, sulla, serradella, and kidney vetch failed at the station. Japan clover grew slowly and "hagy" failed. Beggar weed is condemned as not worth cultivating at the station. Yellow lupine "is useful only for improving the land where the cowpea does not do well." Common vetch gave excellent results, proving superior to hairy vetch and *Lathyrus hirsutus*. The flat pea was not promising, false vetch died, and the goober pea made only a small yield. Alsike clover and common white clover did well. Giant broad-leaved white clover "is much more robust and has larger leaves than the common species, but produces very little seed; . . . it gives more than twice as much herbage and seems as hardy as the other." Mammoth clover proved superior to common red clover on the station farm. Zigzag clover was inferior to both the above. "Crimson clover makes a hay nearly as good as red clover and cures more easily." Unknown and Wonderful proved to be names for a single variety of cowpea which was the most prolific in seed and the most productive of forage of all the varieties tested; the Black pea was second only to the Unknown in the yield of forage. Whippoorwill ripened seed before other varieties, and was followed by the Stewart and Lady pea. The Conch, with stems 12 to 15 ft. long, did not flower. Red Ripper and Capehart Red were prolific. The speckled pea equaled the black in amount of forage and matured earlier than the Black. The soja bean proved prolific.

Experiments with oats, 1893, G. E. MORROW and F. D. GARDNER (*Illinois Sta. Bul. 31, pp. 382–388*).

Synopsis.—Experiments to determine (1) the best quantity of seed per acre, (2) time of sowing, (3) depth of sowing, (4) effect of time and manner of harvesting upon yield and chemical composition. The results in general agree with those previously reported and are in favor of (1) sowing 2½ bus. per acre, (2) sowing about the first of April, (3) planting 1 in. deep, (4) harvesting before fully ripe and binding and shocking soon after cutting in preference to drying thoroughly in the swath before binding.

These experiments are in continuation of those conducted in 1888, 1889, 1890, 1891, and 1892, of which the average results were reported

in Bulletin 23 of the station (E. S. R., 4, p. 815). Pringle Progress oats were sown at the rate of 1, 1½, 2, 2½, 3, 3½, and 4 bus. per acre on 7 plats. The results for 1893 differ from the average results of 6 years chiefly in that 1 bu. of seed per acre gave almost as much grain as 2½ bus. Pringle Progress oats were sown broadcast on some plats at the rate of 80 lbs. of seed per acre, on others at the rate of 100 lbs., on March 31, April 8, April 17, May 3, and May 10. The earlier sowing gave the largest yield and later sowings a uniform decrease in yield. In rows 10 ft. long selected kernels were planted at depths of 1, 2, 3, 4, 5, and 6 in. The largest yield was from planting 1 in. deep.

Tables showing the yield of oats harvested (1) early, (2) medium ripe, (3) fully ripe, (4) bound and shocked soon after cutting, (5) allowed to dry thoroughly before binding, and (6) simply headed, are quoted from Bulletin 23 of the station. Chemical analyses of the grain and straw grown in 1891 and 1892 and of the stubble of 1892 were made. In 1891 there was no notable difference in composition of the grain due to time or manner of harvesting. In 1892 the protein and fat were slightly higher for the early curing and for those bound and shocked.

Varieties of potatoes, H. T. FRENCH (*Oregon Sta. Bul. 30, pp. 69–73*).—One hundred and fifty-three varieties of potatoes were grown on the station farm in 1893, 88 being on plats large enough to warrant a calculation of the yield per acre. The varieties recommended are Dublin Chief, James Vick, Burling, White Lion, Thorburn Late Rose, Dakota Red, Tilden, Early Sunrise, Rochester Favorite, and Silver Skin. Of the newer varieties Coy Seedling No. 88, Salt Lake Rose, and Van Orman Superb are mentioned as promising.

Roots, H. T. FRENCH (*Oregon Sta. Bul. 30, pp. 74–78, pls. 2*).—Tests of 4 varieties of mangel-wurzels, 3 of carrots, and several of ruta-bagas. Orange Grove was the most productive of the mangel-wurzels, Mastodon of the carrots, and Yellow Swedish of the ruta-bagas.

Investigation of roots, F. H. WERENSKIOLD (*Rpt. Chem. Control Sta. Christiania, 1893, pp. 11–27*).—Through the various county agricultural societies 90 samples of roots of various kinds were sent to the station for examination. Information is given in the report on the origin of the samples, their period of growth, yield, soil on which they were grown, fertilizers applied, etc. The samples analyzed included 7 different varieties of carrots, 4 of ruta-bagas, 5 of yellow turnips, 6 of white turnips, and 6 of mangel-wurzels. The extremes of composition found are given in the following table:

Range of composition of roots.

Roots.	Number of samples.	Highest or lowest.	Water.	In dry matter— Ash.	Fat.	Protein.	Crude fiber.	N.-free extract.	Sucrose.	Glucose.	Amide N.
			Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Carrots	21	Highest.	89.72	10.02	2.10	12.19	15.83	74.90	34.61	45.53	69.0
		Lowest.	83.73	6.52	.49	5.47	7.87	68.34	10.76	13.37	37.5
Ruta-bagas	15	Highest.	89.78	8.85	1.42	13.80	13.36	74.22	44.40	57.93	66.7
		Lowest.	85.88	6.10	.35	6.19	9.92	69.34	8.07	4.22	43.0
Yellow turnips	37	Highest.	93.05	12.37	2.79	15.56	16.13	72.34	16.58	*a*52.82	61.3
		Lowest.	86.80	6.74	.28	6.58	11.16	56.04	*a*1.29	28.10	43.0
White turnips	8	Highest.	92.22	9.86	.87	15.90	*b*15.73	*b*63.10	15.55	*c*52.31	61.8
		Lowest.	89.76	7.01	.28	*b*6.68	......	......	*c*4.12	34.15	53.9
Mangel-wurzels	6	Highest.	87.77	11.45	.82	12.43	9.92	75.30	56.90	0.00	71.6
		Lowest.	79.41	5.36	.31	7.87	8.55	65.73	45.78	0.00	47.4

a Same sample. *b* Only one determination. *c* Same sample.

Experiments with sorghum, G. H. FAILYER and J. T. WILLARD (*Kansas Sta. Bul. 43, pp. 93–111*).—This is a continuation of work reported in Bulletin 36 of the station (E. S. R., 4, p. 721), and includes analyses of varieties, improvement by seed selection, effect of fertilizers, and influence of time of day upon the density of the juice. The work of improving sorghum by selecting seeds from individual stalks of special merit has been in progress for 6 years. The following table, giving the sugar content of the juice, shows the great improvement resulting from careful seed selection:

Cane sugar in sorghum juice during 6 years.

	Kansas Orange.		Early Amber.		Link Hybrid.		Cross of Orange and Amber (Denton).		Undendebule.	
	Average.	Best single stalk.	Average.	Best single stalk.	Average.	Best single stalk.	Average.	Best single stalk.	Average.	Best single stalk.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
1888	12.62	15.51	....	....	14.01	14.27	12.70	14.18	....	....
1889	13.88	16.79	13.95	15.56	15.32	16.94	14.83	17.47	....	....
1890	11.65	Frozen	14.37	16.01	10.95	14.47	14.59	16.03	13.47	15.79
1891	16.82	18.59	12.75	16.48	16.37	17.41	16.49	18.25	17.21	18.95
1892	17.30	19.26	15.62	17.23	16.40	17.88	16.72	18.95	18.27	20.39
1893	16.10	19.43	15.79	19.25	....	18.22	16.00	19.85	19.07	19.66

Selected seed from the best varieties will be distributed to farmers of the State on payment of postage.

"[The results of the fertilizer experiment] show that there is nothing to indicate the advisability of applying fertilizers to sorghum grown upon such ground as this, which is upland of moderate fertility. In several cases the yield per acre was increased by the fertilizers, but lime and salt seem to be wholly bad in their effects, reducing the yield of cane per acre and the percentage of sugar in the juice. . . . When we consider the figures relating to the composition of the juice, we find no uniformity in the apparent effect of any fertilizer except lime, which has always been injurious. Sodium nitrate (Chile saltpeter) has the best record on the average, but during the last 2 years has evidently been of no benefit."

Analyses of sorghum juice from canes cut at different hours of the day afford no evidence of an increase of density of the juice with the advance of the day.

Sugar beets, H. A. HUSTON (*Indiana Sta. Bul. 49, pp. 17–40*).—Statistics are given of beet-sugar production, conditions necessary for the growth of beets and manufacture of beet sugar, directions for cultivating beets, results of analyses of beets grown in 1893 in 22 counties in the State, experiments on the time of planting and harvesting, and effect of manure, of scab, and of loosening beets before harvesting on the quality of the beets.

The meteorological conditions for 1893 in most sections of the State were unfavorable. Of 48 samples of beets analyzed the maximum sugar content of the juice was 14.8 per cent, and the maximum purity 88.3. Analyses of beets planted April 7 and May 4, and harvested October 5 and 18, and November 2 and 15 are tabulated.

"The harvest of October 5 found the beets just starting a second growth. The results show that there was an increase in the size of the beet, but that the relative amount of sugar decreased during October, and the purity was reduced. During the first half of November the beets gained in size and in sugar, but the increase in solids-not-sugar was also considerable. The highest purity was found at the first harvest before the effect of the second growth had shown itself."

On a plat manured with a moderate dressing of coarse barnyard manure in the preceding fall the stand of beets was perfect, but on a plat receiving no manure the stand was very defective. In 3 out of 4 varieties the purity and sugar content was less for scabby beets than for smooth ones. Tabulated data for an incomplete experiment on loosening beets before harvesting are given, also brief statements regarding the blister beetle (*Epicauta marginata*), varieties of beets, the value of home-grown seed, and the cost of growing beets. The results of the work of 1893 led to the conclusion that the sugar beet is a promising crop for Indiana.

Experiments with sugar beets, G. H. FAILYER and J. T. WILLARD (*Kansas Sta. Bul. 43, pp. 112–114*).—Analyses of 2 varieties of beets grown on the station farm in 1893 and of 2 varieties grown by 12 farmers in the State are tabulated. Of the beets grown on the station farm the maximum sucrose content was 13.02 per cent, the maximum purity 85. Of the samples grown by farmers the richest contained 14.57 per cent of sucrose, with a purity of 73.

Sugar beets in 1893, E. E. SLOSSON (*Wyoming Sta. Bul. 17, pp. 16–23*).—Brief notes on the methods of culture and tabulated data giving analyses of beets grown in 9 localities in the State in 1893. The average sugar content of the beets was 16.23 per cent; the average purity, 80.91.

Varieties of sugar cane, W. C. STUBBS (*Louisiana Sta. Bul. 26, 2d ser., pp. 836–871*).

Synopsis.—Description of 20 new seedling varieties received from the Royal Agricultural Society of British Guiana; a classification of the varieties grown at the station; tables giving composition and tonnage of the varieties grown on a field scale and on experiment plats for 1892 and 1893; and a comparison of the common striped and purple varieties by means of tabulated data and general notes. The striped cane gave a slightly larger tonnage and larger stalks; the purple cane showed a stronger reproductive power and a higher content of fiber and solids-not-sugar. In all other respects, including sucrose content, they agreed closely.

Classification (pp. 835–842).—The following is the classification adopted:

First class—white, green, or yellow canes.

Group I.—Panache, La Pice, Le Sassier, Tibboo Merd, Bourbon, Crystallina, Green (from Cuba), Light Java, Hope.
Group II.—Yellow, Blanca d'Otaheite, Losier.
Group III.—Portier, Lahaina, Keni Keni.
Group IV.—China, Green Elephant.
Group V.—Rose Bamboo, Salangore, Vulu Vulu.
Group VI.—Pupuha, Kokea.
Group VII.—Uwala, Lakona.
Group VIII.—Cuban, Sacuri.
Group IX.—Caledonia Queen.
Group X.—Creole.
Group XI.—Japanese or Zwinga.
Group XII.—Bamboo.

Second class—striped canes.

Group I.—Malay, Brisbane, Green Rose Ribbon.
Group II.—Red Ribbon, Mexican Striped, Batavian Striped, [Louisiana] Striped.
Group III.—Tsimbic, Ysaquia, Vituahaula, Horne.
Group IV.—Ainakea, Kainio, Akilolo (light striped).
Group V.—Akilolo (dark striped).
Group VI.—Cavengerie, Altamattie, Poaole.

Third class—solid colors other than in first class.

Group I.—Norman, Grand Savenne, Naga.
Group II.—Black Java, [Louisiana] Purple.
Group III.—Breheret, Marabal.
Group IV.—Purple Elephant.
Group V.—Ohia, Honuaula.

First class (pp. 839, 840, 843–847).—The varieties of group I in 1892 and 1893 averaged, respectively, 38.25 and 36.93 tons per acre, 8.42 and 10.30 per cent of sucrose, and 65.98 and 80.69 purity. "By comparing both tonnage and sugar content with our home canes . . . we find these canes fully the equal of our purple or striped varieties."

Analyses and tonnage of 3 of these varieties grown in 1892 as plant cane and in 1893 as first-year stubble are tabulated, as also the composition and tonnage of Tibboo Merd, Marabal, Pupuha, and Batavian Striped when treated with different fertilizers. The members of group II are identical. They averaged in 1892 and 1893, respectively, 39.75 and 38.41 tons per acre, 8.47 and 8.97 per cent of sucrose, and 62.88 and 64.21 purity. "They are slowly becoming acclimated, but are as yet unworthy of extensive cultivation." The members of group III are identical. They germinate slowly, "sucker" and "rattoon" badly, and hence make a defective stand and low tonnage. They averaged in 1892 and 1893, respectively, 38.32 and 29.79 tons of cane

per acre, 6.66 and 9.47 per cent of sucrose, and 56.58 and 68.13 purity. Group IV is closely allied to group III. Group V is characterized by parallel narrow cracks or streaks of a brownish color upon the maturer joints of the stalks. Group VI consists of canes with large tonnage and good sugar content. The two varieties of group VII are closely allied. Group VIII consists of clean, smooth, green canes, medium stalks rich in sugar. The tonnage is not large. "Sacuri has for two years surpassed every variety of cane on the station, foreign and domestic, when submitted to polariscopic tests." Caledonia Queen, constituting group IX, is not recommended. Japanese, or Zwinga, constituting group XI, is "extremely hardy and enormously productive under good cultivation, and exceedingly woody, difficult to crush, and low in sugar." Bamboo has enlarged nodes and prominent eyes.

Second and third classes (pp. 851, 852).—Of the second class only group II, identical with the common striped cane, and group VI, with large, straight, long-jointed, dark-red stalks with faint black stripes. high tonnage, and low sugar content have been tested on a large scale. This is also true of all the groups of the third class.

Varieties originating from bud variation (pp. 841, 842).—Phenomenal stalks of cane, partly white and partly purple, were planted, using on one row entire canes, on another only the white joints, and on another the colored joints. There resulted 4 distinct varieties, different from all others at the station, viz: (1) A white cane, which was named Soniat; (2) a light striped cane, called Nicholls; (3) a light purple cane, named Bird; and (4) a dark striped cane, named Garig.

Tonnage and composition (pp. 852–859).—Tables give tonnage and composition of 49 varieties grown as plant cane in 1892, and as first-year stubble cane in 1893, and of 54 varieties grown as plant cane in 1893.

Windrowing and topping (pp. 862, 868).—The results of experiments in windrowing *vs.* leaving cane standing, and in topping standing cane, are tabulated, but not discussed.

Striped vs. purple cane (pp. 860–871).—The following table gives the results of 174 experiments made at the stations during 4 years (1890–'93) in comparing striped and purple cane under many different conditions:

Tonnage and composition of striped and purple cane.

	Stalks in plat in—			Average weight of stalks.	Yield per acre.	Sucrose.	Fiber.	Purity coefficient.
	May.	July.	Harvest.					
Average, 4 years:				Pounds.	Tons.	Per cent.	Per cent.	
Striped plant cane	411	1,692	1,087	2.89	40.40	9.79	9.24	73.18
Purple plant cane	459	1,769	1,151	2.61	38.48	9.61	10.02	72.36
Average, 3 years:								
Striped first-year stubble	775	1,457	931	2.27	33.22	11.19	10.67	75.91
Purple first-year stubble	869	1,612	1,029	2.03	31.07	11.24	11.14	75.99
One year:								
Striped second-year stubble	606	1,704	840	1.80	23.87	11.50	....	77.86
Purple second-year stubble	747	1,812	852	1.68	24.87	11.58	10.52	78.77
Average of all:								
Striped	597	1,618	956	2.32	32.49	10.83	9.95	76.10
Purple	692	1,731	1,011	2.11	31.44	10.81	10.56	75.80

"In the final summing up we find the following: The striped cane has a larger stalk, gives a slightly larger tonnage, with slightly less solids-not-sugar and fiber. The purple cane is conspicuous for its increased powers of germination and multiplication, and to the latter fact may probably be ascribed the generally smaller stalk. In Brix and sucrose there is a wonderfully close agreement, with but a slight difference in glucose. In fact, beyond the reproductive power of purple and the larger size of stalk of the striped, the 2 canes may be said to be almost identical. Higher fiber and solids-not-sugar attach to the purple and may to some extent modify its manipulation in the mill and vacuum pan. Otherwise the 2 canes are similar.

"In the above table the germinative or reproductive power of the purple exceeded that of the striped by 16 per cent. . . . At harvest 6 per cent more purple stalks existed than striped."

Tobacco, J. G. LEE and W. C. STUBBS (*Louisiana Sta. Bul. 25, 2d ser., pp. 814–832*).—Experiments with varieties and with fertilizers for tobacco. The details of cultivation and of curing are also given. At Calhoun, La., on loose gray sandy soil, with a red sandy clay subsoil which had been cleared of old field pines 2 years before, 12 varieties of bright tobacco were tested, both with and without fertilizers. The fertilizers used consisted of a mixture of nitrate of soda, sulphate of ammonia, dried blood, cotton-seed meal, acid phosphate, and sulphate of potash, applied at the rate of 400 lbs. per acre. The following table gives the yield per acre of the different varieties grown on the above soil with and without fertilizers, and the percentage of loss in weight during curing:

Yield and shrinkage in curing of varieties of tobacco.

No. of plat.	Variety.	Fertilized.		Unfertilized.	
		Cured tobacco per acre.	Loss in curing.	Cured tobacco per acre.	Loss in curing.
		Pounds.	*Per cent.*	*Pounds.*	*Per cent.*
1	Ragsland Improved	600	85.29	210	78.78
2	Conqueror	690	84.45	360	87.36
3	Long-leaf Gooch	690	84.13	510	82.10
4	Hester	540	87.75	510	85.83
5	White Burley	750	86.18	390	88.65
6	Premium	660	85.13	600	77.01
7	Flanagan	750	81.48	270	89.20
8	Sweet Orinoco	615	83.85	450	83.87
9	Famous	600	86.84	480	83.67
10	Climax	910	80.13	510	83.65
11	Yellow Orinoco	690	83.45	609	82.90
12	Hyco	570	84.16	420	84.61

The table shows that with the complete fertilizer the largest yield was made by Climax, followed by White Burley, Conquerer, Long-leaf Gooch, and Yellow Orinoco; without fertilizers, Yellow Orinoco and Premium were most productive.

Eleven varieties of cigar tobacco were grown on red sandy soil somewhat tenacious, and fertilized with 400 lbs. of the complete fertilizer above mentioned. The following table gives the yields per acre in cured tobacco and the percentage of loss of weight in curing:

Yield and shrinkage in curing of varieties of tobacco.

No. of plat.	Variety.	Cured tobacco per acre.	Loss in curing.
		Pounds.	*Per cent.*
1	Connecticut Seed Leaf	1,875	72.09
2	Havana Seed Leaf	1,095	79.92
3	Pennsylvania Seed Leaf	1,080	80.69
4	Vuelta de Abajo	780	81.02
5	Persian Rose	720	81.02
6	Imported Havana	750	81.51
7	East Hartford	9[illegible]0	85.91
8	Choice Havana	1,140	80.71
9	Comstock Spanish	1,160	83.18
10	Pumpelley	1,275	77.39
11	Little Dutch	780	85.71

The largest yield was made by Connecticut Seed Leaf, followed by Pumpelley, Comstock Spanish, and Choice Havana. The crop of tobacco was sold in Durham, North Carolina, Richmond, Virginia, and Jersey City, New Jersey, bringing $135.80 per acre, or, after deducting freight, commissions, etc., $111.58 per acre.

Tobacco plants were furnished to farmers at Shreveport, Monroe, and Mound City, respectively in the Red, Ouachita, and Mississippi River valleys, to ascertain if the alluvial soils of north Louisiana are suited to cigar tobacco. The results were not conclusive. At Baton Rouge the cigar types cured well, and at Hammond both types were successfully grown.

The following table gives the results of a fertilizer experiment occupying 10 plats:

Effect of fertilizers on tobacco.

No. of plat.	Kind of fertilizer used.	Quantity of fertilizer per acre.	Cured tobacco per acre.	Loss in curing.
		Pounds.	*Pounds.*	*Per cent.*
1	Nitrate soda	160	660	70.30
2	Nitrate soda Acid phosphate	160 160	793	75.81
3	Nitrate soda Acid phosphate Muriate potash	160 160 60	850	82.75
4	Nitrate soda Acid phosphate Kainit	160 160 240	740	84.86
5	Nitrate soda Acid phosphate Cotton-seed hull ashes	160 160 140	742	84.79
6	No manure		300	80.54
7	Nitrate soda Acid phosphate Sulphate potash	160 160 60	770	76.66
8	Sulphate ammonia Acid phosphate Sulphate potash	120 160 60	750	77.20
9	Dried blood Acid phosphate Sulphate potash	190 160 60	620	71.87
10	Cotton-seed meal Acid phosphate Sulphate potash	340 160 60	610	72.27

From the table it appears that nitrogen increased the yield.

Improving wheat by selection, N. A. COBB (*Agr. Gaz. N. S. W., 5 (1894), No. 4, pp. 239–250*).—The author's chief object was the selection of rust-proof or rust-resistant plants. He discusses the characters which must be combined in a wheat in order that either its rust resistance may be increased or that its agricultural and commercial value may be augmented. To ascertain the amount of rust the author recommends the use of his scale, by means of which it is possible to determine the proportion of the surface of blade, sheath, and stem that are affected by rust. Wheat plants with purple straw show a greater tendency to rust than those with straw of other colors. Selected plants, besides escaping rust, should combine, among other desirable qualities, the following characteristics: Productiveness, well-shaped grain, stiff, short straw, and narrow, erect, tough, and glaucous foliage. The author insists that selection should be made of whole plants and not of single heads, and in judging a plant he believes it necessary to consider 36 points, the more important of which are noted below.

The plant should stool abundantly, bear all of its ears at the same height, and these should ripen simultaneously. No ear with sterile spikelets should be selected. If the grains in a spikelet are small they should be the more numerous. A top-dressing with soluble manures, followed by timely rains, when the heads are just appearing, tends to produce spikelets with a large number of grains. The more nearly spherical a grain of wheat the smaller the percentage of bran. On the other hand, long grains, though giving a smaller proportion of flour are richer in gluten, a desirable characteristic. If the bran is thin a long grain may be chosen, but if the bran is thick a short grain is desirable. A pointed grain contains more gluten in proportion to its starch. "The deeper the crease the more there is of both bran and gluten, but the grain increases in value with the depth of crease up to any extent yet known to occur."

The thickness of the gluten layer just under the bran varies, and a wheat with a thick gluten layer as determined by microscopic examination should be selected. Small grains contain a larger proportion of gluten than large ones. The less brush there is on a grain the better. The straw of selected plants should be neither flexible, brittle, nor long, but short, stiff, and large. Varieties with long straw are liable to shelling by wind. Beards diminish shelling by lessening the shock of impact against other heads.

The chaff should not be weak, as shown by its thinness and translucency, nor yet brittle, since both of these characteristics are the chief causes of shelling. A stiff chaff, which is desirable, is usually white or yellow and glazed on the surface and has a color of its own independent of the inclosed grain. Compact and upright heads shatter less easily than loose and leaning heads. Varieties with red chaff, with a few marked exceptions, are especially liable to shelling.

In judging of the ripeness of wheat it is claimed to be always neces-

sary to examine the grain, the appearance of the chaff being frequently deceptive. Early varieties have a cuticle less tough and less glaucous than later varieties, larger foliage in proportion to size, and weaker straw, and hence are more subject to rust if suitable climatic conditions prevail. Narrow, erect foliage is desirable, since these qualities are usually accompanied by a tough and glaucous cuticle. Plants with a white and waxy (glaucous) appearance are more resistant of rust than others.

Cost and profit of growing wheat, B. C. BUFFUM (*Wyoming Sta. Bul. 17, pp. 14, 15*).—Statements as to the cost and profit of raising wheat at Lander, Sheridan, Sundance, and Wheatland are given. The average profit was $8.86 per acre, from which should be deducted the cost of seed in one case and the cost of water used for irrigating in two cases.

Crop report for 1893, B. C. BUFFUM (*Wyoming Sta. Bul. 17, pp. 3-13*).—Detailed reports for the crops grown at each of the station farms in 1893. At Laramie, of 36 farm crops planted all failed except potatoes, and the yield of this crop was small. At Lander 4 varieties of wheat, 2 of oats, 1 of barley, 1 of rye, 4 of corn, 1 of peas, 1 of beans, and 12 of potatoes were tested. The largest yields were made by Red May wheat, Early Archangel oats, Mercer corn, and Late Puritan potatoes. At Saratoga only Polish wheat and potatoes matured fully. Of 17 varieties of potatoes the largest yield was made by Blue Victor, 313 bus. per acre. At Sheridan 5 varieties of wheat, 6 of oats, 4 of barley, 3 of rye, and 2 of corn were tested. The following gave the largest yields: Saskatchewan Fife wheat; Wide Awake, Probsteir, and Race Horse oats; Manshury and Duck Bill barley; spring rye, and Self-husking corn. At Sundance 6 varieties of wheat, 6 of oats, 3 of barley, 1 of rye, and 9 of potatoes were grown without irrigation. The largest yields were made by Whittington wheat, Early Archangel oats, and White Elephant potatoes. Buckwheat, corn, and sorghum failed. Two varieties of flax yielded 4½ and 5½ bus., respectively, of seed per acre. At Wheatland 5 varieties of wheat, 2 of oats, 1 of barley, 2 of rye, 2 of buckwheat, 4 of corn, 4 of broom corn, 5 of nonsaccharine sorghum, 2 of peas, 1 of field beans, and 19 of potatoes were tested. The largest yields were made by White Russian wheat, Minnesota King corn, Improved Evergreen broom corn, and Brotillian sorghum. An experiment comparing the value of small potatoes and of large potatoes cut to 2 eyes was repeated with 19 varieties. The whole seed germinated and yielded much better than the cut seed.

Cultivation of coca in India (*Kew Misc. Bul. 89, pp. 151, 152*).

Ceylon coca leaves (*Kew Misc. Bul. 89, pp. 152, 153*).

Coffee cultivation in Angola (*Kew Misc. Bul. 89, pp. 161-163*).

Licorice (*Kew Misc. Bul. 89, pp. 141-146*).

Experiments with corn, C. L. NEWMAN (*Arkansas Sta. Rpt. 1893, pp. 68-72*).—A reprint from Bulletin 22 of the station (E. S. R., 4, p. 807.)

Effect on corn of the different methods of securing fodder, G. L. TELLER (*Arkansas Sta. Rpt. 1893, pp. 119–122*).—A reprint from Bulletin 24 of the station (E. S. R., 5, p. 487).

Experiments with cotton, R. L. BENNETT and G. B. IRBY, (*Arkansas Sta. Rpt. 1893, pp. 85–107*).—A reprint of Bulletin 23 of the station (E. S. R., 5, p. 174).

Changes in the composition and yield per acre of the cowpea during the period from flowering to maturity, G. L. TELLER (*Arkansas Sta. Rpt. 1893, pp. 122–136*).—A reprint from Bulletin 24 of the station (E. S. R., 5, p. 488).

The fertilizing value of cowpeas, G. L. TELLER (*Arkansas Sta. Rpt. 1893, pp. 137–142.*)—A reprint from Bulletin 24 of the station (E. S. R., 5, p. 490).

An Australian forage plant (Atriplex nummularia), J. H. MAIDEN (*Agl. Gaz. N. S. W., (1894), No. 5, pp. 204–213, pl. 1.*)—Analysis, uses, distribution, and propagation.

Forage plants for southern countries, M. MONTARARI (*L'Agr. e Ind. Agr., 27 (1894), No. 10, pp. 147, 148.*)—A popular article with statements regarding *Pisum arvense, Vicia narbonensis. Panicum germanicum* var., *Eleusine corocana, Trigonella corniculata,* and other forage plants tested in Italy.

Trifolium pannonicum, C. DENAIFFE (*Jour. d'Agriculture, 1894, January 20*).—The following is given as the composition of the dry matter of the hay as determined by Stebler:

Composition of the dry matter of Trifolium pannonicum hay.

	Protein.	Fat.	Nitrogen-free extract	Crude fiber.	Ash.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
First cutting	12.28	1.49	45.42	30.42	10.25
Second cutting	12.18	1.89	48.33	27.55	10.25

Our natural pastures, S. FORSBERG (*Tidskr. Landtmän, 15 (1894), pp. 365–370, 383–389*).

The composition of the natural meadows in West Holstein, Dithmarschen, and Eidersted, C. WEBER (*Schriften des naturw. Vereins für Schles. Holst., 9, pp. 179–217; abs. in Centbl. agr. Chem., 23, No. 5, pp. 314–327*).

Manure for natural meadows, O. SENDSTAD (*Norsk Landmandsblad, 13 (1894), pp. 148–150*).

Experiments in manuring and harrowing meadows, J. HANSEN (*Fühling's landw. Ztg., 43 (1894), No. 10, pp. 322–327*).

Lathyrus heterophyllus (*Tidskr. Landtmän, 15 (1894), pp. 249, 250*).

Lathyrus tuberosus tubers (*Kew Misc. Bul. 89, pp. 164, 165*).

On the advantages of oat culture, H. NATHORST (*Tidskr. Landtmän, 15 (1894), pp. 297–300, 334–338*).

Polygonum sachalinense, C. BALTET (*Compt. Rend., 118 (1894), No. 11, p. 607*).—The author has a short note on *Polygonum sachalinense,* in which he states that in his nursery in France it bore seed, apparently for the first time, in 1893. The heat of that year, he believes, accounts for the exceptional fact. He also received from the islands in the sea of Okotsk a quantity of the seed in a perfect state of maturity. He states that this plant may be propagated not only by the expensive method of root cutting, but by the use of seed.

Experiments in potato culture at Alnarp (Sweden), 1893 (*Tidskr. Landtmän, 15 (1894), pp. 221, 222*).

Experiments in potato culture, 1893, H. KNUDSEN (*Landmandsblade, 27 (1894), pp. 164–166, 200–202*).

Ramie, or China grass (*Bul. Bot. Dep. Jamaica, 1 (1894), No. 3 and 4, pp. 33–54*).—Original and compiled information relating to the cultivation and uses of ramie.

Sorghum, W. P. WHEELER (*New York State Sta. Rpt. 1892, pp. 291–294*).—Analyses of 15 varieties of sorghum grown at the station in 1892.

Sorghum and sugar-cane culture, C. L. NEWMAN (*Arkansas Sta. Rpt. 1893, pp. 72–79*).—A reprint from Bulletin 22 of the station (E. S. R., 4, p. 821).

Sirup and crude sugar-making from sugar cane and sorghum, C. L. NEWMAN (*Arkansas Sta. Rpt. 1893, pp. 80–84*).—A reprint from Bulletin 22 of the station (E. S. R., 4, p. 843).

Sugar beet experiments in England, Scotland, and Ireland in 1893, G. S. SOMMER (*Jour. Soc. Chem. Ind., 13 (1894), No. 3, p. 213*).

Turnips and ruta-bagas, G. ALLUARD (*Rev. Hort., 66 (1894), No. 10, pp. 225–227, figs. 3*).—Brief notes on culture and description of varieties.

The wood vetch (Vicia dumetorum), A. VON SOLEMACHER (*Deut. landw. Presse, 21 (1894), No. 41, p. 405*).

Report on crops in Denmark during 1893, K. HANSEN—(*Tidsskr. Landökon., 13 (1894), pp. 27–56*).

Yield of staple crops, C. L. NEWMAN (*Arkansas Sta. Rpt. 1893, p. 72*).—A reprint from Bulletin 22 of the station (E. S. R., 4, p. 825).

HORTICULTURE.

Notes on self-pollination of the grape, S. A. BEACH (*New York State Sta. Rpt. 1892, pp. 597–606*).—Investigations as to the power of different varieties of grapes to produce perfect fruits without cross pollination from other flowers, either on the same plant, other plants of same variety, or plants of a different variety. Seventy-six varieties, distributed among 8 species with their hybrids and crosses, discharged their pollen before the corolla was entirely opened, but not all of them were self-fertile, as was proved by inclosing the clusters of buds in paper bags until the blossoming period had passed. The results seemed to show that varieties having stamens with short filaments were invariably unable to fertilize themselves, and that not all of those with long filaments could do so. But the pollen of varieties that are self-sterile may fertilize other varieties.

"Under the conditions of soil and climate found at this station the following varieties may be expected to prove unfruitful when planted by themselves out of the reach of pollen from other varieties: Black Eagle, Brighton, Eumelan, Massasoit (Rogers No. 3), Wilder (Rogers No. 4), Rogers No. 5, Gaertner (Rogers No. 14), Merrimac (Rogers No. 19), Requa (Rogers No. 28), Aminia (Rogers No. 39), Essex (Rogers No. 41), Barry (Rogers No. 43), Herbert (Rogers No. 44), Salem (Rogers No. 53).

"The following varieties were found able to set fruit of themselves: Concord, Diamond, Niagara, Winchell (Green Mountain), Rogers No. 13, Agawam (Rogers No. 15), Rogers No. 24, Rogers No. 32, Delaware."

Cross fertilization of grapes, S. B. GREEN (*Minnesota Sta. Bul. 32, pp. 229–231*).—To test the self-fertility of grapes, bunches of Moore Early, Lady, Agawam, Ives Seedling, Lindley, and Brighton were inclosed in bags during the blossoming period. Lindley and Brighton were found completely incapable of fertilizing themselves, not a single berry setting, but the others all produced full bunches of grapes.

The effect of rainfall upon pollination—note on preliminary experiments, S. A. BEACH and D. G. FAIRCHILD (*New York State Sta. Rpt. 1892, pp. 607–612*).—Two Duchess grapevines and two Mount Ver-

non pear trees were experimented with to ascertain the truth of the belief common among fruit-growers that excessive rainfall at blooming time is disastrous to the "setting" of fruit. One of each was constantly sprayed during the blossoming period, by means of a Vermorel nozzle thrust up among the leaves and connected by garden hose with the hydrant. The others were left untouched for checks. The pear tree was kept wet for 9 days and 3 hours, with the effect of retarding the development of the flowers, many of which opened and shed abundant and apparently normal pollen after the spraying, though the flowers on the check tree had withered some days previously. The leaves became covered with red-bordered gray spots, persisting all summer. But one pear was borne, bearing 3 seeds, while the check tree produced a fair crop.

The spraying of the grapevine lasted 12 days, retarding the blossoms 4 days, but was discontinued before the blooming was over on either vine. The sprayed vine bore fruit, which ripened at the same time as that of the check vine, but 60 per cent of the berries were abortive, as against 21 per cent from the check.

The experiments are to be continued.

The pollination of pear flowers, M. B. WAITE (*U. S. Dept. Agr., Division of Vegetable Pathology Bul. 5, pp. 110, pls. 12, figs. 5*).—This bulletin is the outgrowth of observations made while investigating the fire, or twig, blight of the pear. The experiments conducted on the prevention of blight by excluding insect visits from the flowers gave results that seem to indicate that many of the well-known varieties of pears are incapable of self-fertilization, and consequently fail to set fruit. In a measure this serves to explain the unfruitfulness of many orchards.

Experiments were conducted on 144 trees, representing 36 varieties, at Brockport, Rochester, and Geneva, N. Y., and Chestnut Farm, near Scotland, Va. From the experiments, the details of which are given, it was found that 22 varieties are either wholly or in part incapable of setting fruit from self-fertilization and require pollen from some other variety to render them fertile, while 14 varieties are self-fertile. The list is as follows: Self-sterile varieties—Anjou, Bartlett, Boussock, Clairgeau, Clapp Favorite, Columbia, De la Chene, Doyenné Sieulle, Easter, Gansels Bergamotte, Gray Doyenné, Howell, Jones, Lawrence, Louise Bonne de Jersey, Mount Vernon, Pound, Sheldon, Souvenir du Congres, Superfin, Wilder (Colonel), and Winter Nelis. Self-fertile varieties—Angoulême, Bosc, Brockworth, Buffum, Diel, Doyenné d'Alençon, Flemish Beauty, Heathcote, Kieffer, Le Conte, Mannings Elizabeth, Seckel, Tyson, and White Doyenné.

The author studied the effect of pollen on the fruit in order to ascertain (1) what, if any, was the difference between self-pollinated and cross-pollinated fruit, and (2) the difference between different kinds of crosses. A great contrast was noticed between the self-pollinated and cross-pollinated fruit. The tendency of self-pollinated fruit is to

be narrower and not well filled out towards the blossom end, due principally to lack of development of the ovules. Some varieties, however, are capable of producing perfect fruit without the fecundation of the ovules. In fact, most of the close-pollinated fruit was entirely seedless. There was a tendency in self-pollinated fruit to be slightly later in ripening than the crosses, as well as being somewhat smaller. In comparing the crosses with each other but slight differences were noted. The difference between the seeds of the two was the most marked. The self-pollinated fruit was seedless or nearly so. The external characters of cross-pollinated and close-pollinated fruit, together with the seed characters, enable one readily to judge to which class a given fruit belongs.

The author considers the effect exerted on fruit production by the vegetative vigor of the tree, the influence of weather during flowering time, the time of blooming of different varieties, of insect visitors, and of diseases.

Similar experiments were conducted on the apple and quince. The varieties of apple are more inclined to be sterile to their own pollen than is the case of the pears. In the majority of cases no fruit resulted from self-pollination. The quince seemed to fruit as well with its own pollen as with that of another variety.

The following summary and practical conclusions are given by the author:

"(1) Many of the common varieties of pears require cross pollination, being partially or wholly incapable of setting fruit when limited to their own pollen.

"(2) Some varieties are capable of self-fertilization.

"(3) Cross pollination is not accomplished by applying pollen from another tree of the same grafted variety, but is secured by using pollen from a tree of a distinct horticultural variety, *i. e.*, which has grown from a distinct seed. Pollen from another tree of the same variety is no better than from the same tree. This failure to fruit is due to the sterility of the pollen and not to mechanical causes.

"(4) The impotency of the pollen is not due to any deficiency of its own, but to the lack of affinity between the pollen and the ovules of the same variety.

"(5) The pollen of two varieties may be absolutely self-sterile and at the same time perfectly cross-fertile.

"(6) The state of nutrition of the tree and its general environment affect its ability to set fruit either with its own pollen or that of another tree.

"(7) Bees and other insects are the agents for the transportation of pollen.

"(8) Bad weather during flowering time has a decidedly injurious influence on fruitage by keeping away insect visitors and also by affecting the fecundation of the flowers; conversely, fine weather favors cross pollination and the setting of fruit.

"(9) Pears produced by self-fertilization are very uniform in shape. They differ from crosses not only in size and shape, but also in some cases in time of maturity and in flavor.

"(10) Among the crosses the differences were slight or variable, so that their variations are not to be ascribed with certainty to differences in pollen.

"(11) Self-fecundated pears are deficient in seeds, usually having only abortive seeds, while the crosses are well supplied with sound seeds.

"(12) Even with those varieties which are capable of self-fecundation the pollen of another variety is prepotent, and unless the entrance of foreign pollen be pre-

vented the greater number of fruits will be affected by it, as shown by the study of Buffum pears.

"(13) The normal typical fruits and in most cases the largest and finest specimens either of the self-sterile or self-fertile sorts are crosses.

Practical conclusions.—"(1) Plant mixed orchards, or at least avoid planting solid blocks of one variety. It is not desirable to have more than 3 or 4 rows of one variety together, unless experience has shown it to be perfectly self-fertile.

"(2) Where large blocks of trees of one variety which blossomed well have failed to fruit for a series of years without any apparent reason, it is exceedingly probable that the failure is due to lack of cross pollination. The remedy is to graft in other varieties and supply foreign pollen.

"(3) Be sure that there are sufficient bees in the neighborhood or within 2 or 3 miles to properly visit the blossoms. When feasible endeavor to favor insect visits to the blossoms by selecting sheltered situations or by planting wind-breaks."

Protection of grapes against spring frosts, F. HOUDAILLE (*Prog. Agr. et Vit., 11 (1894), No. 13, pp. 325–329; No. 14, pp. 357, 358*).—The author briefly reviews the methods proposed for lessening the injuries wrought by spring frosts on young grape shoots, citing a few French vine-growers who have used each system. The methods proposed for use before frost occurs are late pruning, use of screens and of dust, and watering the soil. Prof. Carré (Department of Haute-Garonne) observed in 1892 that the varieties which made an early growth were the ones which suffered most from frost. The author inclines to the belief that late pruning, by delaying the growth of the shoots, is advisable. The value of screens is admitted, but their cost precludes their use. The use of some powder or dust was found by Carré to be effective when applied to vines trained in a unilateral cordon, but ineffectual when trained in goblet shape. Andrieu tried whitewashing with a thick milk of lime, but with scarcely appreciable effect. In another case the application of dry plaster in April, 1893, proved a failure. Near Tunis in the same month sprinkling with sulphured milk of lime was efficacious. Several instances are mentioned in which watering the soil resulted favorably.

For use during the time that the temperature is low enough for frost the author recommends artificial clouds produced by burning tar or other substances. One instance is cited in which the tar, instead of being burned in metallic vessels, was poured into small holes made in the soil. Artificial clouds gave satisfactory results only when the air was still and when the thermometer stood not lower than 2° C.

The author states that viticulturists are divided in opinion as to the method of pruning frosted shoots and even as to the advantages of pruning frosted vines at all.

Chlorate of potash in mushrooms, E. BOURQUELOT (*Bul. Soc. Mycol. France, 10 (1894), No. 2, pp. 88, 89*).—The presence of chlorate of potash in mushrooms has been known since 1866, when it was discovered by Boudier in *Amanita phalloides*, *A. muscaria*, and *Boletus edulis*. Since then various authors have added to the list of species containing

this salt. The author, while studying the presence of sugar in mushrooms, met with chlorate of potash in many species, a list of 22 being given. It is most abundant in *Amanita phalloides* and *Boletus cynescens*, where he found as much as 0.5 per cent of the salt in the fresh mushroom.

Analyses of fruit trees, P. COLLIER (*New York State Sta. Rpt. 1892, pp. 173-209*). The relation of parts of the tree, composition of the ash of the various parts, and the calculated amounts of the various ash constituents per tree or shrub are given for 3 varieties of apples, 4 of cherries, 8 of peaches, 2 of crab apples, 8 of pears, 4 of plums, and 2 of quinces, and a mixture of varieties of grapevines. The data are fully tabulated. It is evident that young nursery stock is under consideration, for it is estimated that "with rows 4 feet apart and trees 1 foot apart in row there would be on an acre 10,890 trees, weighing 23,299 lbs., or over 11 tons." Taking the average composition of the nursery stock named, the ash in the 11 tons would contain approximately the following amounts of ingredients:

Mineral matter removed by nursery stock per acre.

	Pounds.		Pounds.
Silicic acid	51.63	Lime	160.09
Phosphoric acid	19.71	Magnesia	20.60
Sulphuric acid	10.88	Soda	11.62
Chlorine	1.49	Potash	21.01
Carbonic acid (estimated)	147.40		
Ferric oxide	3.93	Total	448.36

For comparison the mineral ingredients removed by cereal crops are given.

"Since upon an average it requires from 3 to 4 years to grow the crop of nursery stock the cereals make a far greater demand upon the soil than the growing of nursery stock, and it is a matter of common observation that the removal of a crop of trees leaves the soil in excellent condition for the growth of cereals."

The results of experiments during four years in fertilizing the grapevine, E. ZACHAREWICZ (*Prog. Agr. et Vit., 11 (1894), No. 1, pp. 17–24; No. 3, pp. 62–68; No. 6, pp. 143–150*).—The experiments reported were carried out on a number of farms in France during a period of 4 years. On each farm used, 18 plats were laid out, each plat usually consisting of 100 vines. The fertilizers used were nitrate of soda, nitrate of potash, sulphate of ammonia, sesame cake, chloride of potash, sulphate of potash, carbonate of potash, superphosphate, and gypsum, applied in various combinations.

On most soils nitrate of soda proved the best form of nitrogen. On a soil rich in nitrogen and in potash and moderately rich in acid phosphate, nitrate of soda produced a luxuriant vegetation to the detriment of the crop of grapes. Here sulphate of ammonia was found to be more advantageous; potash in its several forms produced no conspicuous effect.

In conclusion the author recommends nitrate of soda for the sedimentary Alpine soils poor in nitrogen, and sulphate of ammonia or sesame cake for those very rich in nitrogen. For the alluvial soils along the Rhone he considers nitrate of soda and sulphate of ammonia as of equal value. Carbonate of potash usually gave the largest crop, but the sulphate is recommended on account of its less cost and because it makes a richer wine. Superphosphate increased the harvest and produced a favorable effect in maturing the wood of the vine. Plaster is recommended for soils rich in organic matter and potash and poor in lime.

Tomatoes, L. C. CORBETT (*South Dakota Sta. Bul. 37, pp. 16*).—Results of experiments, with suggestions for the cultivation of tomatoes in South Dakota, and remarks on combating the attacks of insects and diseases. Experiments were made with seeds from green, sun-ripened, and normal fruit, with cuttings, and with different methods of training and pruning the plants, with the following summary of conclusions:

"(1) There is not enough gain to warrant the additional trouble and expense of sowing tomato seeds before March 1, and for the ordinary field crop they should not be planted later than the middle of March.

"(2) Single-stem training makes the crop earlier, but reduces the quantity materially.

"(3) Seeds from green fruits gave larger fruits and a greater weight of fruit per plant than sun-ripened or normal.

"(4) Cuttings are decidedly earlier and more productive during the early part of the season than normal or parent plants.

"(5) Pruning plants before setting in the field retards maturity of the fruit.

"(6) The 3 best varieties tested were Dwarf Champion, Early Ruby, and Early Advance."

Tomatoes, W. M. MUNSON (*Maine Sta. Bul. 9, 2d ser., pp. 4*).—Conclusions as to culture reached from the work with tomatoes during 1893. The plants should be set as early in the spring as possible, and they prove more vigorous and productive if started in pots before setting in the field. Crosses often proved at first more productive than either parent, but tended to quickly "run out." Ignotum, Matchless, Optimus, Ithaca, and Longkeeper maintained their reputation, and Burpee Climax, Maule Earliest, and Brinton Best are considered promising among the newer varieties.

Cauliflowers, W. M. MUNSON (*Maine Sta. Bul. 10, 2d ser., pp. 4*).—Remarks on the culture, varieties, and cooking of cauliflowers. The soil conditions and general culture should be much like those for cabbage, and it was found best to start the young plants in pots before the early setting out. Thorough and frequent cultivation and bringing the outer leaves together and tying them a few days before cutting, to bleach the heads, is advised. The earlier varieties proved more satisfactory, as Burpee Best Early, Dwarf Danish, Kronk Perfection, Livingston Earliest, Alabaster, and Snowball.

Fruit-growing in Kentucky, and notes upon vegetables, C. W. MATHEWS (*Kentucky Sta. Bul. 50, pp. 27–53*).—The first part of this

bulletin is compiled from answers to circulars sent out to about 200 fruit-growers in the State, asking the varieties preferred by them. Of apples named for home use, the following are the first 6: Early Harvest, Winesap, Ben Davis, Rome Beauty, Maiden Blush, and Rawle Janet, while the same varieties lead for marketing in a slightly different order, with Ben Davis first. Of peaches are named Oldmixon, Crawford Early, Crawford Late, Smock, Heath Cling, Stump the World, and Mountain Rose; while of pears, Bartlett, Kieffer, and Seckel are grown most generally. Among grapes, Concord, Catawba, Ives Seedling, Delaware, Niagara, Martha, Moore Early, Pocklington, Brighton, and Worden head the list; and among strawberries, Crescent, Bubach, Haverland, Gandy, Kentucky, Sharpless, and Wilson.

Directions are given for combating insects and diseases.

The second part of the bulletin gives brief notes on experiments with vegetables on the station land. Several varieties each of sweet corn, peas, tomatoes, and bush and pole beans were grown.

Michigan fruit list, L. R. TAFT (*Michigan Sta. Bul. 105, pp. 106–122*).—This is a list of the favorite varieties of various fruits, and is compiled from the answers to circulars sent to some 200 fruit-growers in different sections of the State. Eighty-nine varieties of apples are included, and the following 20 varieties are recommended as a good family collection for nearly all sections of the State: Red Astrachan, Bough (sweet), Oldenburg, Primate, Chenango, Keswich, Maiden Blush, Shiawassee, Twenty Ounce, Bailey (sweet), Westfield, Jonathan, Hubbardston, Grimes, Baldwin, Tolman, King, Rhode Island Greening, Red Canada, Northern Spy, and Golden Russet (N. Y.). Five varieties of crab apples are given, and Hyslop and Transcendent are preferred. Apricots and nectarines do not thrive in Michigan, but 3 varieties of each are cited, and 15 of blackberries, Stone, Snyder, and Taylor being put first. Among cherries, 11 varieties of the Heart and Bigarreau type and 13 of Dukes and Morellos are given, and Black Tartarian, Governor Wood, Early Richmond, May Duke, Wragg, and Vilne Sweet are recommended. Ten varieties of currants are given, and Prince Albert recommended. Four varieties of gooseberries are grown, Downing the more extensively. Of 30 varieties of grapes, Worden, Concord, Delaware, Salem, Brighton, Niagara, and Winchell (Green Mountain) are selected as proving of most value. Thirty-one varieties of peaches are given, with Barnard, Bronson, Early Michigan, Angle Mammoth, Gold Drop, Hale, Kalamazoo, Lewis, Smock, and Snow Orange in the lead for market varieties, Mountain Rose and Oldmixon Free to be added for home use. From among 42 varieties of pears named, Bartlett, Anjou, Bosc, Clapp Favorite, Flemish Beauty, Howell, Seckel, and Sheldon are those most desired. Twenty-four varieties of European and 3 of Japanese plums are listed as grown in the State, and Bradshaw, Coe Golden Drop, Lombard, Pond (English), and Shropshire Damson are given the preference. Orange leads the 4 varieties of

quinces that are listed. Of 24 varieties of raspberries, Shaffer, Palmer, Gregg, Conrath, Ohio, Hansell, Marlboro, Cuthbert, and Turner are best liked. Twenty-two varieties of strawberries are named, with Bubach No. 5, Crescent, Cumberland, Haverland, Parker Earle, Sharpless, Warfield, and Wilson as the favorites.

Strawberries and raspberries, L. R. TAFT and H. P. GLADDEN (*Michigan Sta. Bul. 106, pp. 123–135*).—Notes on varieties and results obtained in 1893. One hundred and eighteen varieties of strawberries were tested, and a table is given showing the sex, vigor, dates of bloom, first and last ripe fruit, productiveness, size, form, color, quality, and firmness. A few of the leading varieties were grown in rows 18 rods in length, Bubach producing 60¾ quarts, Haverland 60½, and Gandy and Lower 45½ and 43, respectively. Twenty-seven varieties were grown in narrow matted rows with 25 plants in a space of 40 feet. Parker Earle gave 20 quarts, Greenville 16¾, Hattie Jones and Woolverton 16 each, and Leroy 15½. Notes on the vigor and productiveness are given for 31 varieties, and especial attention called to Clyde, Greenville, Leroy, No. 2 (Feicht), Weston, and Yankee Doodle, among the new kinds. Bubach, Crescent, Cumberland, Haverland, Minor, Sharpless, Warfield, and Wilson are recommended as market varieties, and for home use Cumberland, Great Pacific, and Sharpless.

Bordeaux mixture, 3 lbs. of copper sulphate and 3 lbs. of fresh lime to 32 gals. of water, is advised against leaf blight and rust, with the addition of 2 ozs. of Paris green if leaf-eating insects are present.

Twenty varieties of black and hybrid raspberries and 12 of red were tested, and tables are given showing the points mentioned for strawberries. Of the black, Conrath, Kansas, Nemaha, and Gregg are recommended, and of the red, Cuthbert and Golden Queen. In case of anthracnose all badly diseased canes should be cut out and Bordeaux mixture used, spraying just before the growth starts and repeating every 2 weeks until the fruit is half grown.

Varieties of cantaloupes, C. L. NEWMAN, (*Arkansas Sta. Rpt. 1893, p. 67*).—A reprint from Bulletin 22 of the station (E. S. R., 4, p. 828).

On the permanency of races in mushrooms, COSTANTIN and MATRUCHOT (*Compt. Rend., 118 (1894), No. 20, pp. 1108–1111*).

The tree tomato (Cyphomandra betacea), J. H. MAIDEN (*Agl. Gaz. N. S. W., 5 (1894), No. 4, pp. 214–217, pl. 1*).—Habitat, culture, uses, and propagation.

Garden vegetables, B. C. BUFFUM (*Wyoming Sta. Bul. 17, pp. 24–30*).—This consists of lists of the vegetables grown at the various State experiment farms: At Laramie, asparagus, beans, cabbage, cauliflower, lettuce, peas, beets, radishes, and turnips; at Saratoga, beans, cabbage, cauliflower, lettuce, peas, squashes, and tomatoes; at Sundance, beans, sweet corn, peas, beets, carrots, parsnips, turnips, and salsify; at Wheatland, beans, sweet corn, beets, carrots, parsnips, and sweet potatoes.

Vegetables grown for exhibition, S. A. BEACH (*New York State Sta. Bul. 69, n. ser., pp. 249–302, figs. 3*).—Annotated and tabulated lists of the varieties of bush beans, bush and pole Limas, beets, Swiss chards, carrots, sweet corn, pop corn, cress, cucumbers, eggplant, gourds, lettuce, muskmelons, watermelons, okra, onions, parsnips,

peas, peppers, radishes, salsify, squashes, tomatoes, and turnips sent by the station to the New York horticultural exhibit at the World's Fair, with remarks on the relative value of the different varieties, and special methods of cultivation and shipment employed.

The farmer's apple orchard, D. W. BEADLE (*Ontario Agl. College Bul. 92, pp. 13–18*).—A popular article on the culture of apples in Ontario, with remarks on soils, pruning, varieties, and spraying for diseases and insects, with receipts for the remedies to be used.

"[For home use] the following varieties are named about in the order of ripening: Yellow Transparent, Red Astrachan, Oldenburg, Chenango, Gravenstein, Ribston Pippin, Blenheim Pippin, Snow [Fameuse], Tompkins King, McIntosh, Tolman Sweet, Sutton Beauty, Baldwin, Pewaukee, Northern Spy, Grimes Golden, Golden Russet, Roxbury Russet; and in planting for market, selection can be made with advantage from Oldenburg, Gravenstein, St. Lawrence, Ribston Pippin, Wealthy, Blenheim Pippin, Tompkins King, Baldwin, Northern Spy, Golden Russet, Ontario, Roxbury Russet, Rhode Island Greening and Westfield Seek-no-further."

Variety tests of apples, S. A. BEACH (*New York State Sta. Rpt. 1892, pp. 586–596*).—Descriptive notes for 10 varieties new to the station farm, and tables showing the yield and age before bearing fruit, for 93 varieties. Where the young trees were planted they produced fruit in about 8 years, while the average time for 79 varieties that had been top-worked was 5.72 years.

Peach and plum culture in Michigan, L. R. TAFT (*Michigan Sta. Bul. 103, pp. 3–62, figs. 9*).—A popular article on peach and plum orchards, with directions as to soil, location, planting, cultivation, pruning, fertilizing, harvesting the fruit, and preventing the attacks of insects and diseases. The following varieties are recommended: Peaches—Hale, Lewis, St. John, Richmond, Barnard (or Snow Orange), Jacques, Gold Drop, Late Barnard, Hill Chili, Smock; plums in the order of ripening—Duane Purple, Washington, Bradshaw, Green Gage, Lombard, Jefferson, Prince Englebert, Geuii, Imperial Gage, Pond, Quackenboss, German Prune, Damson, Shropshire Damson, Coe Golden Drop, Fellemburg, and Bavay.

Notes on early and late blooming peaches (*U. S. Dept. Agr., Division of Statistics, Rpt. 115, May, 1894*).—In reply to a circular sent out by the Division of Pomology, 560 replies were received.

"In reply to the inquiry regarding the varieties of the peach which have been observed to bloom later than others, 78 varieties are named by one or more correspondents.

"Owing to the great diversity in the varieties of this fruit grown in the different regions from which reports were received, and the lack of reports on any very widely distributed variety which can be taken as a standard for comparison, it has not been possible to determine what one or more varieties bloom later than all the others in different latitudes. It is evident, however, that the early ripening varieties, such as Alexander (including Amsden), Rivers, and Hale, have been found to be the latest bloomers by the largest number of observers. These varieties, all of which are white fleshed, and most of which are semiclingstones having large blossoms, seem to constitute the most widely distributed late-blooming group of the Persian race. They are planted in small numbers, however, in most of the market-peach regions, because of the inferior quality of their fruit and its susceptibility to rot.

"The reports indicate that in lateness of blooming the latest ripening varieties stand next to the very early ones. This group, of which Smock, Salway, Fox Seedling, Picquet Late, Heath Cling, and Bilyeu are leading representatives, includes varieties having both large and small blossoms, white and yellow flesh, and both clingstones and freestones. The larger number of the well-known and widely distributed varieties in this group are yellow-fleshed freestones, having small or medium sized blossoms."

Condition of peach buds, S. T. MAYNARD (*Massachusetts Hatch Sta. Bul. 25, p. 18*).—A brief note on the condition of the peach buds at the station March 20, 1894, nearly all of them being winterkilled.

Plum culture, G. W. CLINE (*Ontario Agl. College Bul. 92, pp. 25–29*).—A popular article treating of the soil, preparation, planting, cultivation, fertilizing, varieties, marketing, and prevention of diseases and insect attacks. The following varieties are recommended for most localities in Ontario, especially if the soil contains clay: "Bradshaw, or Niagara, Duane Purple, Imperial Gage, Washington, Smith Orleans, Huling Superb, McLaughlin, Lombard, Pond Seedling, Glass Seedling, Quackenboss, Yellow Egg, German Prune, and Reine Claude de Bavay."

Manuring of fruit trees, A. ANDOUARD (*L'Engrais, 9 (1894), No. 21, pp. 496–498*).

Strawberry culture, W. W. HILBORN (*Ontario Agl. College Bul. 92, pp. 19–23*).—A popular article on the growing of strawberries, urging their more general cultivation in Ontario, and recommending Beder Wood, Crescent Seedling, Bubach, Wilson, Woolverton, Saunders, Lovett, and Williams as suitable varieties.

Further study of native grapes, E. A. POPENOE and S. C. MASON (*Kansas Sta. Bul. 44, pp. 115–127*).—Report on 100 varieties grown in the station vineyard, with reference to the botanical classification, hardiness, quality, liability to disease, and comparative earliness; and diagrams showing the classification and earliness.

Report on varieties of grapes fruited in 1893, S. T. MAYNARD (*Massachusetts Hatch Sta. Bul. 25, pp. 15–18*).—One hundred and twenty-five varieties fruited in the station plats, and tabulated data are given for 116 varieties, two vines of each being grown, one of which was sprayed and the other left untouched as a check.

Variety tests of grapes, S. A. BEACH (*New York State Sta. Rpt. 1892, pp. 612–641*).—Descriptive notes for 200 varieties of grapes, fruiting in the station vineyards with mention of the species from which they have sprung.

A year among fruits, T. T. LYON (*Michigan Sta. Bul. 104, pp. 63–105*).—Report on the operations at the South Haven Substation during 1893. Owing to the attacks of insects and fungus diseases the year before, it was found necessary to do extensive spraying with Paris green and Bordeaux mixture, which proved so effective and thorough a remedy that very little trouble was experienced afterward. The results for each kind of fruit are tabulated. There were tested 167 varieties of strawberries, 59 of raspberries, 29 of blackberries, 3 of service berries, 23 of currants, 15 of gooseberries, 60 of cherries, 5 of mulberries, 170 of peaches, 2 of nectarines, 146 of grapes, 40 of plums, 13 of pears, 4 of apples, 7 of quinces, 4 of chestnuts, and 1 each of chinquapin, pecan, English walnut, Japan walnut, almond, filbert, hazelnut, and fig. Notes are also given for several of the leading varieties.

Fruits: notes on varieties, S. B. GREEN (*Minnesota Sta. Bul. 32, pp. 239–247*).—Report on the testing of 7 varieties of plums, 7 of apples, 4 of Juneberries, 8 of grapes, and 47 of strawberries. Attacks by the leaf roller were checked by mowing off the old strawberry leaves, and spraying the new foliage with Paris green.

Progress report upon fruits, B. C. BUFFUM (*Wyoming Sta. Bul. 17, pp. 31–34*).—Brief notes on the results of the second year in testing fruits. Strawberries, raspberries, blackberries, grapes, currants, gooseberries, apples, plums, cherries, pears, apricots, quinces, buffalo berries, and Juneberries are being grown, but nearly all suffered more or less from the cold winter.

Fruit statistics (*Ontario Agl. College Bul. 92, pp. 30, 31*).—The number of bearing and nonbearing apple, pear, peach, plum, and cherry trees and grapevines in Ontario in 1892 and 1893.

Notes on vegetables, fruits, pruning, etc., G. COOTE (*Oregon Sta. Bul. 29, pp. 51–68*).—Results of the comparative testing of varieties of cabbage, celery, tomatoes, squash, beets, lettuce, kale, beans, apples, plums, peaches, service berry, currant, gooseberry, raspberry, blackberry, mulberry, strawberries, and grapes, with remarks on the pruning of plums, and the effect of fertilizing on fruit and vegetables.

Report of the assistant horticulturist, C. E. HUNN (*New York State Sta. Rpt. 1892, pp. 682–696, 700*).—Notes on the varieties of strawberries, raspberries, blackberries, currants, gooseberries, and beans grown at the station, with tabulated data for the strawberries and raspberries, directions for spraying with Bordeaux mixture, and a description of the rose bug.

Thirty-four varieties of potatoes and 25 of tomatoes are listed in the order of their productiveness.

Fruit-Growers' Association of Ontario.—Among the articles in the Twenty-fifth Annual Report of the Fruit-Growers' Association of Ontario, 1893, are the following: Modification of fruits by climate, J. Craig; Notes on the chemistry of the copper salt fungicides, F. T. Shutt; and Desirable ornamental trees, shrubs, and plants, W. Saunders.

Horticultural experiments and notes, J. T. STINSON (*Arkansas Sta. Rpt. 1893, pp. 35–62*).—A reprint of Bulletin 21 of the station (E. S. R., 4, p. 828).

Reports of the annual meetings of the Viticultural Society of Cognac for 1893 and 1894.—These comprise reports from the administrative council on the general work of the society and of the station for viticulture, a special report by the director of the station on vine culture in Cognac, a report to the Minister of Agriculture reviewing the work done under the direction of the society, and a paper by the director of the station for viticulture on soils in different parts of Cognac.

Dictionnaire d'Horticulture, part I, D. BOIS (*Paris: P. Klincksieck, 1893, pp. 160, figs. 112*).—This new work is more on the order of an encyclopedia than of a dictionary. It is the work of 27 contributors, and is advertised to be issued in 8 parts, with over 1,000 illustrations, many of them colored. This first part comprises from *A* to *Bambusa*.

Gardening for Farmers, F. J. C. JENSEN (*Copenhagen: 1894, fourth edition*).

Danish Gardening, F. J. C. JENSEN (*Copenhagen: 1894, sixth edition*).

Window Gardening, F. J. C. JENSEN (*Copenhagen: 1894, sixth edition*).

FORESTRY.

Forest trees, B. C. BUFFUM (*Wyoming Sta. Bul. 17, pp. 34, 35*).—A brief mention of cottonwoods and Russian willows grown at the experiment farms for windbreaks, and honey locust for hedge. Ash and elm are also being grown, and all are doing well.

The theory and practice of forest management, DORRER (*Forst. u Jagdw., 70 (1894), pp. 165–171*).

The influence of removing dead trees on the growth of those remaining, M. KUNZE (*Tharand. Forst. Jahrbuch., 44 (1894), No. 1, pp. 1–48*).

Investigations concerning the structure and properties of oak timber (*Ztschr. naturw. Forst., 3 (1894), No. 5, pp. 193–203*).

Comparative anatomical studies of pine and larch wood, A. BURGERSTEIN (*Denkschrift f. kaiserl. Acad. Wissensch. Math. natur. Classe, 59 (1893), pp. 395–432; abs. in Bot. Centbl., 58 (1894), No. 6, pp. 214, 215*).

Sunshine through the woods, B. D. HALSTED (*Pop. Sci. Monthly, 1894, July, pp. 313–322*).—Describes a method of making solar prints of wood.

SEEDS—WEEDS.

A machine for preparing seeds that germinate with difficulty (*Braunschw. landw. Ztg., 62 (1894), No. 19, p. 86*).—A brief description, with illustration.

German vs. American red clover seed—a reply to Prof. Nobbe, J. L. JENSEN (*Ugeskr. Landmänd, 39 (1894), pp. 214, 215, 224–226*).

Nevada weeds, F. H. HILLMAN (*Nevada Sta. Bul. 22, pp. 11, pls. 3*).—Descriptions and specimens are given of squirrel-tail grass (*Hordeum jubatum*), *Franseria hookeriana*, poverty weed (*Iva axillaris*), shepherd's purse (*Capsella bursa-pastoris*), and pepper grass (*Lepidium intermedium?*). The first three are illustrated by photo-engravings.

DISEASES OF PLANTS.

Potato diseases and their treatment, S. B. GREEN (*Minnesota Sta. Bul. 32, pp. 215–228, figs. 5*).

Synopsis.—Popular reports on treatment for the prevention of potato rot and potato scab.

Potato rot (pp. 215–221).—The late blight, or rot (*Phytophthora infestans*), of potato is described and illustrated. References are made to experiments conducted at various stations for the prevention of this disease. At this station 2 experiments were conducted, and they showed a considerable increase in the crop as the result of the application of Bordeaux mixture. In the first experiment there was an increase of about 30 per cent. due to the application of the fungicide. The tops of the treated rows were more vigorous in every way, and remained fresh and green for more than 2 weeks after the tops of the untreated varieties were dead. In the second experiment there was little or no blight present in any part of the field, yet the difference in the appearance of the treated tops was quite marked. When harvested the yield from the treated plat showed an increase of 50 bus. per acre over the check. This increase seemed to be due to the larger size of the treated tubers. In the treated rows all the potatoes were merchantable, while in the others about 10 bus. per acre of tubers were too small for market. The cost of material and application need not exceed $4 per acre, and as the increase due to the treatment is often as large as 50 bus. per acre it will considerably more than pay for the application. Paris green and London purple as insecticides are recommended to be used in connection with Bordeaux mixture.

Potato scab (pp. 222–228).—Illustrated descriptive notes on the cause of potato scab (*Oöspora scabies*). As showing the importance of preventing drainage water from flowing from infected to noninfected ground, the author cites a case in which water from an infected field flowed over a field never previously used for potatoes. The results clearly showed that the scab fungus was carried from one field to the other.

The importance of the use of clean seed and the uselessness of planting potatoes in infected soil are pointed out. Directions are given for the treatment of scabbed seed with a solution of corrosive sublimate before planting, and this treatment is considered as having given excellent results at the station. The use of Bordeaux mixture for soaking the seed is also mentioned, but it did not give as complete results as the corrosive sublimate. The usual precautions are given for the treatment of seed and for the kind of soils in which the potatoes are to be planted.

Parasitic diseases of legumes, G. McCarthy (*North Carolina Sta. Bul. 98, pp. 151, 152*).—Brief mention is made of the occurrence of *Septoria dolichi*, *Uromyces* sp. and *Glœosporium* sp. on cowpeas and of a species of *Erysiphe* on alfalfa. From the nature of the crops but little can be done with fungicides in preventing these diseases, but reliance must be placed on clean fields, proper drainage, use of stimulating fertilizers, and avoidance of stable manure.

Dodders (*Cuscuta trifolii* and *C. epithynum*) are described and the importance of sowing only clean seed shown. Clover sickness is mentioned, and, although it is not yet known in this country, a rotation of crops is advised in which clover will only occupy the ground at intervals of 4 or 5 years.

Rust on wheat (*Board of Agr. Great Britain, Rpt. Intelligence Dept. 1892, pp. 44, pls. 4*).—A report of investigations made in Great Britain and elsewhere on the cause, nature, and possible means of repression of wheat rust (*Puccinia graminis*). Reports received from various sources give losses due to rust in varying amounts, some reporting as great a loss as 50 per cent. In England the date of appearance of the uredo, or ordinary rust form, is from June 10 to July 20, and of the teleuto, or black rust, from July 19 until the end of harvest. The influence of soil was investigated, but it seems that soils have but little effect upon attacks of rust, light, gravelly ones being as much affected as those of a heavy clay or alluvial nature. J. B. Lawes and A. Voelcker are quoted as maintaining that grain grown on soil rich in organic matter and having an excess of nitrogenous foods will, when other conditions are favorable, be more liable to attack than where there is a large amount of available mineral matter at the disposal of the plant.

Date of sowing seems to bear an important part in the damage done by the rust, early sown grain being less liable to attack than late sown.

The effect of weather is reported, and wet weather with a deficient temperature, resulting in what is termed a bad season and a thin crop, seems very favorable for spread of rust.

The following conclusions are given based upon observations made in various countries:

"Seasons are the chief cause of rust. Sudden changes of temperature and rain, accompanied by close, sultry weather, are favorable to its increase. Low-lying rich

soils are most subject to its attacks. An excessive use of manures rich in nitrogen encourages the disease. Late-sown grain crops are the most liable to the attack. Thinly sown crops are most liable to rust."

A report is given of the experiments made in Australia on the growth of resistant varieties. The most promising results are along two lines:

"Rust-resisting wheats, by which are meant wheats which, in localities suited to their growth and under normal conditions, resist at all seasons of the year either the entrance of the rust mycelium into their tissues or its subsequent growth and outburst. Of this class many examples are known. . . .

"Rust-escaping wheats, that is to say, wheats which are rust liable, but which if sown at the proper time ripen so early as to be ready for harvest before the rust of an ordinary season can prevent a paying crop."

In the first group the following characteristics have been found by an examination of 12 varieties:

"The possession of a thick and tough skin, so tough that though the mycelium may enter the plant by means of the open stomata, yet it can not break through the skin in order to mature and shed its spores, so that its further development is prevented. And, secondly, the presence of waxy exudation on the surface of the plants similar to the bloom of fruit; this waxy covering, when present about the mouth of the stomata, prevents the rust mycelium from entering. Wheat plants possessing tough skins, and especially if possessing toughness of the skin in conjunction with the waxy bloom, may be grown under all conditions suitable to their normal growth without suffering seriously from rust. On the other hand, rust-liable wheats, which are characterized by the possession of a thin and tender skin, and often by the absence of waxy bloom, can be grown successfully during a rusty year only in one way, namely, by sowing at such time as the plant shall be only for a short time subject to the attacks of the rust fungus."

Brief reports are given of the occurrence of rust in Germany, India, Japan, and the United States. The life history of the rust is given in detail.

The means suggested for the repression of rust are burning infested straw and spraying the infested plants. The spraying of wheat with copper and other solutions has given conflicting results.

A detailed report on the investigation of rust-resistant varieties of wheat is given, in which it appears that a thick epidermis and glaucous or waxy bloom, preventing the entry of the sporidia or the emergence of the mycelium to form sori for the further propagation of the fungus, are the essentials for such varieties. The report concludes with a chapter on the spring rust, *Puccinia rubigo-vera*.

Report of the horticulturist, S. A. BEACH (*New York State Sta. Rpt. 1892, pp. 530–585, 642–677, pls. 9, figs. 16*).—*Some bean diseases* (pp. 531–556).—A reprint from Bulletin 48 of the station (E. S. R., 4, p. 557.)

Leaf spot of chrysanthemums (pp. 557–560).—A report on a disease of chrysanthemums prevalent in the station greenhouse during 1891. The disease first appeared in small dark-brown spots which increased in size and number until the leaf tissue died and the foliage dropped off. In badly diseased plants nearly all the leaves withered and fell away; even

when the attack was less serious it left the plants unsightly and not nearly so vigorous and thrifty as healthy plants. Specimens submitted to B. D. Halstead are reported as affected by a species of *Septoria.* Three fungicides were tested as preventive measures, namely, potassium sulphide, ammoniacal copper carbonate, and Bordeaux mixture. The Bordeaux mixture proved the most effective and the potassium sulphide the least. The treatment suggested is to remove and burn all the diseased foliage and cover the remaining foliage with Bordeaux mixture to prevent further development of the disease. Five or six applications will usually be sufficient for the season.

Experiments in the treatment of potato scab (pp. 561–570).—A reprint from Bulletin 49 of the station (E. S. R., 4, p. 925).

Some celery diseases (pp. 570–585).—A reprint from Bulletin 51 of the station (E. S. R., 4, p. 925).

Experiments in preventing leaf diseases of nursery stock in western New York (pp. 642–677).—A reprint of a paper by D. G. Fairchild, published in Journal of Mycology, 7, pp. 240–264 (E. S. R., 4, p. 955).

On the use of blue vitriol for pourridié of grapes, J. DUFOUR (*Rev. Internat. Vit. et Œnol., 1 (1894), No. 2, pp. 75–77*).—Since 1888 experiments have been conducted at the station of Lausanne in combating the pourridié of the grape. They were conducted in a variety of soils and with various fungicides. Other experiments were conducted at Champ-de-l'Air on plants grown in pots and artificially infected. Some experiments were successful, while others failed.

The disease is due to various causes, the principal of which are *Dematophora necatrix* and *Agaricus melleus.* General preventive measures, such as aëration and draining of soils and the use of more resistant stocks, are recommended. When the disease once gains a firm hold in a vineyard the complete destruction of all vines together with their roots is advised. Before setting new vines in their places the soil should be disinfected by watering it with a 3 per cent solution of copper sulphate. Where the disease is just appearing the roots of the affected plants and 2 or 3 rows about them should be laid bare in the spring and washed and the soil well watered with the 3 per cent solution of copper sulphate. The effect of the treatment may not be visible the first year and it may be necessary to repeat the treatment the second spring, but it is believed that the use of the blue vitriol in the manner suggested will ultimately be attended with positive results.

Fifth Annual Report of the Halle Station for experiments in the repression of nematodes and for plant protection, 1893, M. HOLLRUNG (*pp. 44*).—During the year 410 experiments of several kinds were made, chiefly in the line of fertilizing, but also toward checking injurious insects and plant diseases.

Experiments on the application of various fertilizers to "beet-sick" soil were carried on at Körbisdorf, Trotha, Biere, Atzendorf, and Bleckendorf, 5 plats at each place being treated, respectively, with potassium

chloride, common salt, no fertilizer, kainit, and carnallit. The most sugar was produced where potassium chloride was used, and the least with carnallit. The kainit had less effect on nematodes than was expected, and in several cases the results were contradictory to those of previous experiments.

In experiments on the effect of applying kainit at different seasons to nematode-infested land, various amounts were applied in the fall, in the fall and spring, in the spring, and as top-dressing, to different plats, from 1891 to 1893, but the results were conflicting and inconclusive.

Researches as to the effect produced by other salts associated with potash fertilizers showed that hydroscopic salts were advantageous in dry weather by loosening the soil and preventing it from caking.

A wheeled apparatus for spraying with Bordeaux mixture was satisfactorily employed among potatoes and beets and is figured.

There are notes on 20 species of insects injurious during the year and on 9 plant diseases, especially *Phoma betæ*, which was quite prevalent, owing to the dry weather, and in some cases to the application of lime as a fertilizer.

Fungicides and insecticides, S. T. MAYNARD (*Massachusetts Hatch Sta. Bul. 25, pp. 1–15, pls. 2*).—The bulletin gives formulas for Bordeaux mixture, ammoniacal carbonate of copper, copper sulphate solution, arsenites, and kerosene emulsion, with directions for their use. A spraying calendar is given in which preventive methods are suggested for the more common diseases affecting fruits, etc.

A brief report is made on the rust of poplars (*Melampsora populina*) giving the results of 4 applications of Bordeaux mixture. The sprayed trees were healthy, while the check ones were badly diseased.

Brief suggestions are given to those contemplating the purchase of spraying apparatus.

Reports are given on the use of fungicides and insecticides upon the fruit trees of the station. Applications were made to apple, pear, peach, cherry, and plum trees, all of which were attended with beneficial results. Quinces, raspberries, blackberries, currants, gooseberries, and strawberries were sprayed with success, but no records are given.

The Uredineæ and their host plants, G. POIRAULT (*Jour. Bot. France, 8 (1894), No. 9, pp. 173–177*).

Notes preliminary to a revision of the linosporous species of North American graminicolous Hypocreaceæ, G. F. ATKINSON (*Torrey Bul. 19, pp. 222–225*).

Blighting of blossoms, B. D. HALSTED (*American Florist, 19, p. 1093*).

Concerning insects and fungus injuries (*Centbl. Forstw., 20 (1894), No. 5, pp. 214–221*).

Concerning the reason why some parasites are harmless, BOUCHARD and CHARRIN (*Abs. in Centbl. Bakt. u. Par., 15 (1894), No. 17, pp. 652, 653*).

Rots of stone fruits, L. R. TAFT (*American Agriculturist, 1894, June*).

Basal rot of daffodils, W. CRAWFORD (*Gard. Chron., ser. 3, 15 (1894), pp. 625, 626*).

The treatment of black rot in grapes, A. DE L'ECLUSE (*Rev. Internat. Vit. et Œnol., 1 (1894), No. 4, pp. 143–147*).—A theoretical consideration of the cause and course of this disease and of the remedial methods practiced.

Downy mildew of grape, M. C. COOKE (*Gard. Chron., ser. 3, 15 (1884), pp. 689, 690*).—A popular article on the appearance of this disease in England, its description, and suggested preventive treatment.

Diseases affecting the grape, J. H. PANTON (*Ontario Agl. College and Exptl. Farm Bul. 92, pp. 11, figs. 8*).—Popular illustrated notes on the downy mildew, or brown rot (*Peronospora viticola*), black rot of the grape (*Læstadia bidwellii*), powdery mildew (*Uncinula spiralis*), and anthracnose (*Sphaceloma ampelinum*), with directions for combating them with fungicides, formulas for which are given.

Five hundred and fifty-one replies were received to a circular letter regarding the diseases of the grape, and 120 report downy mildew, 105 powdery mildew, 106 black rot, and 14 anthracnose. These diseases caused a loss of from 50 to 75 per cent of the crop. The varieties most attacked are Rogers hybrids, Concord, Clinton, Niagara, Brighton, and Delaware.

Concerning Cycloconium oleaginum, U. BRIZI (*Staz. Sper. Agr. Ital., 26 (1894), No. 3, pp. 227–231*).—A description of a fungus disease of the olive.

Treatment of potato plants and tubers for rot, M. MONTARINI (*L'Agr. e Ind. Agr., 27 (1894), No. 9, pp. 130, 131*).—The record of an experiment in which plants and tubers were treated with Bordeaux mixture and milk of lime.

Bordeaux mixture used to prevent potato blight, C. E. HUNN (*New York State Sta. Rpt. 1892, pp. 696–699*).—A reprint from Bulletin 49 of the station (E. S. R., 4, p. 561).

Red smut of sugar cane, F. A. F. C. WENT (*Sugar Cane, 26 (1894), pp. 312–314*).

Sugar-cane disease, W. T. T. DYER (*Kew Misc. Bul. 89, p. 154*).

ENTOMOLOGY.

On certain grass-eating insects, a synopsis of the species of Crambus of the Ithaca fauna, E. P. FELT (*New York Cornell Sta. Bul. 64, pp. 47–102, pls. 14, figs. 8*).

Synopsis.—Introduction, synopsis of species, description of species, the affinities of species, bibliography and recorded distribution of the North American species of the genus Crambus, and explanation of plates.

This paper is mainly a technical monograph, but in the introduction the destructive habits of the crambid larvæ in feeding upon the leaves of grasses, cereals, and sedges are treated of, though the injury they inflict is usually inconsiderable. Burning of the infected tract in late fall or early spring, while the larvæ are hibernating in their nests at the bases of the grass stems, is recommended, as also rolling the ground and deep plowing.

Three tables are given, the first an artificial key for the identification of 26 species, the second showing the periods of flight for 14 species, and the third synoptical, based on a study of the exterior genital organs of 26 species.

Sixteen species of snout moths are described and their habits noted, as follows: the yellow crambus (*Crambus luteolellus*), sooty crambus (*C.*

caliginosellus), dried crambus (*C. interminellus*), dark-spotted crambus (*C. mutabilis*), blue-grass worm (*C. teterrellus*), rustic crambus (*C. ruricolellus*), vagabond crambus (*C. vulgivagellus*), Leach crambus (*C. leachellus*), yellow-striped crambus (*C. giradellus*), pretty crambus (*C. elegans*), unmarked crambus (*C. innotatellus*), garden crambus (*C. topiarius*), white crambus (*C. albellus*), white-striped crambus (*C. alboclavellus*), flowery crambus (*C. floridus*), and paneled crambus (*C. laqueatellus*). The larvæ are preyed upon by a number of insects, particularly carabids and ants, and by such true parasites as *Lampronata frigida*, *Cryptus mundus*, *Perilampus violaceous*, and a species of *Tachina*.

The relationships were traced by means of the wings and genitals, which are figured in the plates, as also eggs of some of the species.

Additions to the knowledge of the morphology, biology, and pathology of the Nonne moth (Psilura monacha), and experiments with methods for destroying the caterpillars, F. A. WACHTL and K. KORNAUTH (*Mitt. Ver. Förd. landw. Versuchw. Oesterr., 1893, No. 16, pp. 38, pls. 3, figs. 8*).—This recounts a series of investigations on means of checking the destruction of pine forests by this insect. The rapid spreading of the devastations is partly due to the peculiar anatomy of the newly hatched larvæ, which are covered with long barbed hairs, intermingled with shorter ones bearing spherical enlargements containing air and serving as little balloons to farther buoy up the already light caterpillars, so that they are floated on the wind for long distances.

Panthea cœnibita is figured for comparison, as it has been confused with lighter individuals of the adult moth, but hot dry weather tended to produce melanism in the Nonne, when it could be easily distinguished.

Many Diptera and Hymenoptera were found to be parasitic on the Nonne in varying numbers, but not so abundantly as to materially decrease the caterpillars.

In the application of a patent insect lime toward preventing the invasion of the older caterpillars, which at times drop from the trees to the ground and proceed to fresh localities, it was found that though they were able to crawl over a band of the lime on a horizontal surface, they were checked when the band was in a vertical plane. Trees can then be protected by painting a ring of the lime around their trunks, and even forests to some extent by setting narrow planks on edge around them and coating the outside with lime, or possibly by felling small trees, laying them end to end,and smearing the lime along their sides.

Bacterium monachæ proved quite destructive in some places, but could not be induced to grow in tube cultures, so that efforts to transport it for distant inoculation were unsuccessful.

Experiments with various insecticides showed that antinonnin (Orthodinitro-kresol-kalium) was effective on single trees in solutions of 1 part by weight to 450 or 500 parts of water, but would hardly be

practicable for spraying whole forests. Slaked lime and water also gave good results, but several patent mixtures failed.

Insecticides, C. H. FERNALD (*Massachusetts Hatch Sta. Bul. 24, pp. 1–11*).—Arsenate of lead, arsenate of soda, and a mixture of Paris green and lime were tested on tent caterpillars to learn their advantages as insecticides. Arsenate of lead proved very satisfactory, as it remained suspended in the water some time, and could readily be seen on the leaves, which it did not injure, even at the rate of 25 lbs. to 150 gals. of water. From 1 to 2 lbs. to 150 gals. of water is advised, the arsenate of lead to be produced by combining 29.93 per cent of arsenate of soda with 70.07 per cent of acetate of lead, by weight. A recommended formula is 4 ozs. of arsenate of soda and 11 ozs. of acetate of lead to 150 gals. of water, 2 qts. of glucose or molasses added to cause the insecticide to adhere to the leaves.

Arsenate of soda in proportions strong enough to kill caterpillars had the effect of badly burning the leaves.

Paris green and freshly slaked lime in equal parts did not injure the leaves, even when 6 lbs. of each to 150 gals. of water was used, but acted very slowly on the caterpillars.

An infusion of the leaves of Jamestown weed (*Datura stramonium*) was tried as an insecticide against potato beetles, with negative results.

Wintering bees in the ground, E. LEPLAE (*Rev. Agron., 1894, No. 1, pp. 1–8*).—This article contains some general remarks on apiculture, and the details of some experiments on sheltering bees from the cold of winter by burying the hives in the earth. Holes were dug, the hives, stocked with honey, placed in them, and the soil packed around them. In the first experiment, 1890–'91, the bees died from insufficient food.

In the subsequent trials in 1892–'93 and 1893–'94, more honey was supplied and the result proved successful, a much smaller proportion of the bees being found dead, after 3 months interment, than in the hives that had wintered above ground. There appeared to be no loss from suffocation.

Bees and honey, H. HOVIND and E. HANSEN (*Christiania: 1894, pp. 424*).

Planting for honey, J. H. LARRABEE (*Rural Canadian, 17, p. 137*).

Experiments in feeding silkworms, M. F. LAMBERT (*Montpellier: C. Boehm, 1894, pp. 16*).—One hundred worms of each of two races, a Chinese (Pai-pi lung Chiao Tsan) and a French (Cévennes), were used in the experiments, and fed on the same kind of leaves. The French race consumed the greater amount of leaves but also produced more silk.

The leaves of the "Tonkin" mulberry compared with those of other varieties in regard to their value for feeding to silkworms, M. F. LAMBERT (*Montpellier: C. Boehm, 1893, pp. 25, dgm. 1. Extr. Ann. de l'École Nat. d'Agric. de Montpellier*).—Two hundred silkworms were experimented with, 50 being fed on "Tonkin" leaves and 50 on the leaves of each of three other varieties. The worms did not thrive so well on the "Tonkin" diet, nor did the silk prove as much as that from the worms fed on the other leaves. The "rose" mulberry gave the best results.

Notes on a few species of reared Coleoptera, F. M. WEBSTER (*Entomological News, 1894, May, pp. 140, 141*).—Brief notes on 8 species.

Progress of work in entomology, F. L. WASHBURN (*Oregon Sta. Bul. 31, pp. 79-88, pls. 2, figs. 3*).—A brief report on experiments toward destroying codling moths, hop lice, flea beetles, radish flies, wireworms, cutworms, and tent caterpillars, with recommendations of chemical and mechanical insecticides. An automatic gun for killing gophers and moles is described and figured. The plates are from photographs of insects and damage done by them.

Report on insects and fungi injurious to crops, C. WHITEHEAD (*London: Eyre & Spottiswoode, 1893, pp. 60, pls. 10*).—A report prepared for the Great Britain Board of Agriculture on the insects and diseases that were especially damaging to various crops in 1892. Descriptions, life histories, and remedies are given, and supplemented by 10 colored plates. The following species are treated: The currant moth (*Incurvaria capitella*), the Y moth (*Plusia gamma*), raspberry moth (*Lampronia rubiella*), cabbage fly (*Anthomyia brassicæ*), mangel-wurzel fly (*Anthomyia betæ*), frit fly (*Oscinis frit*), grain aphis (*Siphonophora granaria*), turnip aphis (*Aphis brassicæ*), raspberry beetle (*Byturus tomentosus*), pea and bean weevil (*Sitones lineatus*), red spider (*Tetranychus telarius*), raspberry mite (*Phytoptus rubi*), black-currant mite (*Phytoptus ribis*), apple-blossom weevil (*Anthonomus pomorum*), club root (*Plasmodiophora brassicæ*) and black mold in corn (*Cladosporium herbarum*).

The horn fly, C. H. FERNALD, (*Massachusetts Hatch Sta. Bul. 24, pp. 11-15, figs. 2*).—A popular account of the horn fly (*Hæmatobia serrata*), with figures, description, life history, damage, and remedies. Sprinkling lime over the fresh dung or spreading it out to dry quickly before the larvæ have matured is advised, as also applications of train, or fish, oil and carbolic acid to the cattle, or spraying them with kerosene or fish oil emulsion.

Insect enemies of legumes, G. MCCARTHY (*North Carolina Sta. Bul. 98, pp. 152-154*).—Descriptive notes and life histories are given for the pea weevil (*Bruchus pisi*), bean weevil (*B. faba*), clover-seed midge (*Cecidomyia leguminicola*), clover-root borer (*Hylastes trifolii*), and clover-hay worm (*Asopia costalis*), and remedies advised for their destruction; plowing under for the midge and root borer, and carbon bisulphide for the others.

New greenhouse pest, G. C. DAVIS (*American Florist, 19, p. 1062*).

The scale insect of the beech (*Rev. Eaux et Forêts, 33 (1894), No. 9, pp. 215-221*).

On diseases of insects, especially the May bug (Melolantha vulgaris), J. E. V. BOAS (*Ugeskr. Landmand, 39 (1894), pp. 155-157, 168-171*).

Investigations on the influence of bacteria on caterpillars, K. ECKSTEIN (*Ztschr. Forst. u. Jagdw, 26 (1894), No. 5, pp. 285-298*).

FOODS—ANIMAL PRODUCTION.

Changes taking place in the silo, P. COLLIER (*New York State Sta. Rpt. 1892, pp. 162-173*).

Synopsis.—The loss in ensiling was studied in 3 experiments with corn fodder and 3 with sorghum. The average loss for all amounted to 12.6 per cent of the dry matter, 18.5 of the albuminoids, and 26.6 of the starch and sugar. The amide nitrogen increased 3.7 per cent during ensiling. With one exception the silage was in good condition when taken out.

To observe the changes taking place in ensiled corn and sorghum, experiments were made with each in 3 different years. In each case 3 bags holding 50 lbs. each were filled with the green material and placed in different parts of the silo. The corn was in a "medium glazed"

condition when put in. The sorghum was mostly Early Amber and ranged from seeds in hard dough to ripe condition. Samples of the green material were analyzed when the silo was filled and the contents of the bags were analyzed separately when the silo was opened. The data are tabulated. With the exception of one bag of corn the silage was in good condition when taken from the silo. The amounts of food nutrients put in and taken out of the silo and the average percentage of loss are shown in the following table:

Losses in ensiling corn fodder and sorghum.

Material.	Water.	Dry matter.	Ash.	Albuminoids.	Crude fiber.	Nitrogen-free extract.	Crude fat.	Albuminoid nitrogen.	Amide nitrogen.	Sugars and starch.
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
Corn put in	38.24	11.76	0.60	0.53	3.62	5.65	0.61	0.085	0.13	3.54
taken out	36.60	10.93	0.51	0.80	2.43	6.22	0.97	0.128	0.04	3.50
Sorghum put in	38.56	11.44	0.56	0.99	2.63	6.22	0.56	0.158	0.08	6.24
taken out	36.93	8.34	0.45	0.48	2.72	4.12	0.57	0.077	0.04	1.22
put in	37.07	12.93	0.53	0.88	2.81	8.48	0.25	0.141	0.00	4.70
taken out	34.14	12.68	0.65	0.64	3.14	7.78	0.47	0.102	0.05	2.99
Corn put in	34.94	15.06	0.48	0.03	2.95	10.09	0.49	0.165	0.01	6.17
taken out	34.40	12.41	0.56	0.75	2.49	7.46	1.15	0.120	0.05	5.19
put in	36.87	13.13	0.54	0.95	2.64	8.02	0.84	0.152	0.03	5.51
taken out	35.69	12.53	0.52	0.75	2.30	8.01	0.95	0.120	0.07	5.45
Sorghum put in	35.63	14.37	0.51	0.68	2.85	9.84	0.46	0.109	0.01	4.96
taken out	34.95	11.91	0.53	0.70	2.70	7.42	0.56	0.112	0.02	4.48
Average amount put in	36.89	13.12	0.537	0.843	2.917	8.05	0.535	0.135	0.043	5.187
amount taken out	35.45	11.47	0.525	0.687	2.630	6.835	0.778	0.110	0.045	3.805
Per cent lost in silo	3.90	12.60	0.400	18.50	9.800	15.100	+45.40	18.70	+3.70	26.600

"From the preceding experiments it will be seen that as an average of the results there was a loss of 12.6 per cent of the dry matter, and a loss of 18.5 per cent of the albuminoids and of 26.6 of the sugars and starch—two of the most valuable food constituents.

"The apparent increase of 45.4 per cent of crude fat is doubtless due to the fact that in the fermentation in the silo a larger percentage is rendered soluble in ether, and this 'ether extract' is what is termed crude fat in the table.

"The degree of uniformity which exists in the triplicate samples taken from the silo shows that the silo is well constructed, and, it will be observed, that in but a single case was the silage in other than an excellent condition. . . .

"In no other way can the corn crop be so economically harvested and both grain and stalks so well prepared, almost regardless of the vicissitudes of weather, as in placing it, when at its maximum food value, promptly in silo where, until consumed, it requires no further care and expense."

Experiments on the digestibility of oats as affected by heating them to 100° C., H. WEISKE (*Landw. Vers. Stat., 43, No. 6, pp. 457–475*).—To determine the effect of heating oats to 100° C. on their digestibility the author used 2 male rabbits, each fed 80 gm. of air-dry oats daily. The first received ordinary oats, and the second oats which had been heated to 100° C. in dry air for 24 hours and then at the same temperature in moist air for the same time. The object of the heating was not only to coagulate the soluble albuminoids, but also to kill the ferment which, according to V. Hofmeister, aids in the digestion of the albuminoids and in the production of sugar.

The feeding was in two periods, January 28 to February 20, and February 21 to March 9. In the second period the rabbits were reversed, No. 1 receiving the heated oats and No. 2 the raw. In both periods the agreement in the digestibility of the raw and heated oats was very close, giving as the result of the investigation that the prolonged heating of the oats to 100° C. had not rendered them less digestible than the raw oats.

Two control animals of the same litter which were fed on hay and a little oats made a large gain in weight and developed a heavier skeleton, with more mineral matter, than rabbits fed exclusively on oats. The proportion of lime, phosphoric acid, carbonic acid, potash, soda, etc., in the fat-free and water-free bones was lower in the case of the exclusive oats feeding, though the magnesium was the same for all. Compared on the basis of the bone ash, the difference in percentage of lime disappears, and the main difference remaining is in respect to the carbonic acid. The smaller amount of mineral matter in the bones of the rabbits fed exclusively on oats was due more largely to the deficiency ("loss") of lime than of phosphoric acid. The author comes to the conclusion that the above-mentioned ill effects of exclusive oats feeding on the live weight, and especially on the bones, is not due to a lack of lime in the food, but principally to the acidity arising from the acid ash and the sulphuric acid formed in the body from the sulphur of the albuminoids, etc. This has been true in all cases where oats or grain have been fed to rabbits for some time without the addition of a fodder having an alkaline ash (as hay, etc.). Hence he assumes that all continued feeding of such "acid food" to herbivora will have an ill effect similar to that following the addition of acid or acid salts to the food.

Bread from lupine seed as human food, H. WEISKE (*Landw. Vers. Stat.*, *43*, *No. 6*, *pp. 451–457*).—The author recommends lupine-seed meal as a means of making bread richer in protein and decreasing the cost. Being the richest of cultivated leguminous seeds in protein, growing on light sandy soils, and utilizing the nitrogen of the air, it seems well adapted to this purpose. The meal can be mixed with rye flour or with the potato and rye mixture often used. The bitter, poisonous alkaloid of the seed must be removed, and this the author does by cooking the lupine seed (yellow) in water for an hour, and then washing it with cold running water. The treated seed had an agreeable nutty taste and was not bitter. A quantity of this was ground, giving 3 products, namely, flour (42.82 per cent), coarse meal (42.60), and bran (11.72). The fine flour contained 49.25 per cent of protein, or 56.25 per cent in dry matter, and was of a yellow color and pleasant taste. The 2 other products were adapted as food for stock. By removing the outer husk before grinding a flour was obtained from disembittered lupine which contained 70.19 per cent of protein and 8.54 per cent of fat in dry matter.

Bread was made from mixtures of the first lupine flour (with 49.25 per cent of protein) with rye meal, and with rye meal and potatoes, in different proportions, and for comparison from the rye meal containing 6.81 per cent of protein. The following table shows the mixtures and the composition of the bread:

Analyses of bread with and without lupine meal.

No.	Kind of bread.	Water.	In dry matter—Crude protein.	Crude fat.	Crude fiber.	Nitrogen-free extract.	Ash.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
1	Rye alone	37.33	9.25	0.14	0.12	89.28	1.21
2	2 parts rye, 3 of potatoes, 1 of lupine flour	41.05	11.94	0.35	0.11	86.18	1.42
3	3 parts rye, 2 of potatoes, 1 of lupine flour	35.45	13.81	0.43	0.11	83.60	2.05
4	5 parts rye, 1 part lupine flour	35.89	16.06	0.38	0.11	81.51	1.94
5	2 parts each of rye, potatoes, and lupine flour	42.08	18.88	0.70	0.22	78.65	1.55
6	4 parts rye, 2 parts lupine flour	41.68	21.69	0.65	0.22	75.63	1.81

The yellow color of the lupine flour gave a yellowish color to the bread. The bread from mixtures 2 and 4 was especially successful; it had an agreeable taste and was in every respect palatable and good. The others were not all as good, that from 6 especially being heavy and less palatable. Bread from 2 and 4 was eaten by two persons in place of rye bread for a long time without tiring of it.

The lupine flour may also be used with potatoes in soups, etc., to advantage, and without danger of injuring the taste or palatability of the food.

The investigation of the several breeds of dairy cattle, with reference to their relative value in the production of milk, butter, and cheese, P. COLLIER (*New York State Sta. Rpt. 1892, pp. 39–152*).—This is a continuation of the investigation of Jersey, Guernsey, Ayrshire, American Holderness, Devon, and Holstein breeds of cows, and records the data for nearly the whole of the second period of lactation. The record for the first period was given in the annual report of the station for 1891 (E. S. R., 4, p. 255). The data presented includes the individual record by months for each of the 23 cows, showing amount of food and of food ingredients eaten, the yield and composition of milk, the yield of milk ingredients, the relation of food to production, the cost of milk production, and other data mentioned under dairying. The data are not summarized by breeds so as to present easy comparison of the breeds except in respect to the cost of food. This is given for each breed in the first and second periods of lactation as follows:

Average cost of food with different breeds of cows in first and second periods of lactation.

	Cost of food per head daily.		Cost of food per pound of milk.		Cost of food per pound of fat.	
	First period.	Second period.	First period.	Second period.	First period.	Second period.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
Holstein	16.76	19.31	0.925	0.810	26.3	26.4
Ayrshire	14.05	17.35	0.879	0.858	24.3	24.8
Jersey	13.86	14.16	1.127	0.966	20.0	18.5
American Holderness	11.42	14.05	0.928	0.779	26.3	22.8
Guernsey	12.77	17.34	0.985	0.899	18.4	15.6
Devon	10.48	14.64	0.908	0.897	23.0	19.0

"While the estimated cost of the several constituents making up the rations of these animals has been kept the same for both years for greater ease of comparison, the average daily cost of each animal for food during the second period has been 16.17 cts., while for the first it was 13.11 cts., or as 123.3 to 100; the average cost of milk the second period was but 90.6 per cent of the cost for the first period; and the cost of the fat for the second period was 95.6 per cent, upon an average, of the cost during the first period of lactation.

"The increased cost of food during the second period was due to the natural increase demanded for maintenance, the cows having averaged about 40 lbs. increase in weight during their second period over their weight during the first. . . .

"It is to be observed that there is very great differences in the individual animals as to the relative cost of production of milk and fat for the 2 periods."

As to the relation between the fat in the food and in the milk, the data for all the cows for three years show that the food contained 8,277 lbs. of crude fat, and the milk 7,145 lbs. of fat. Allowing 17.4 per cent for the average impurity in the crude fat, the food contained 95.67 per cent as much fat as was found in the milk. Again, 20 cows in their first period of lactation consumed in all 5,421 lbs. of pure fat and yielded milk with 5,108 lbs. of fat. Fourteen of these cows consumed 3,570 lbs. of pure fat and yielded milk with 2,973 lbs. of fat, or only 83.3 per cent of the fat consumed; while the remaining 6 cows consumed 1,851 lbs. and produced in milk 2,135 lbs., or 15.3 per cent more than was consumed. It is suggested that these facts "give reason for the belief that it is this fat in the food which normally furnishes that found in the milk."

The consumption of water has also been recorded. During 3 years the cows consumed on an average 2,435 lbs. of water per month while in milk, and 1,586 lbs. while dry, a difference of 849 lbs. While in milk 68.2 per cent of the water consumed was taken as drink and the remaining 31.8 per cent in the food; and while dry 65.5 per cent was taken as drink and 34.5 per cent in the food. The excess of 849 lbs. consumed while in milk is partly accounted for by the water in the milk.

Comparison of dairy breeds of cattle with reference to production of butter, L. L. VAN SLYKE (*New York State Sta. Rpt. 1892, pp. 467–494*).—A continuation of a report of the data on the subject given in the annual report of the station for 1891 (E. S. R., 4, p. 255). Data are given for Ayrshire, Devon, Guernsey, American Holderness, Holstein, and Jersey breeds of cattle for a part of the second period of

lactation. It was found possible by the aid of the separator to make butter with a total loss of only 0.11 per cent of the total fat in the milk, and this factor was used in calculating the yield of butter from the individuals of the different breeds. As the data for the second period of lactation can not be given with fullness, the individual record is tabulated in the report and discussion of the results is reserved until the record is complete.

Feeding trials with different breeds of swine, W. P. WHEELER (*New York State Sta. Rpt. 1892, pp. 286–290.*)—Poland China, Duroc, and Berkshire pigs, from 4 to 8 of each breed, were fed from birth until 39 weeks old, and the cost of gain determined. For the first 14 weeks the pigs were fed with the sows. After that they received corn meal, wheat bran, middlings, ground oats, and cotton-seed meal in various combinations, but no skim milk was fed during the trial. The gain in weight, food eaten, and cost of food per pound of gain are tabulated for each lot. The Poland Chinas and the Berkshires made the largest gains. The cost of food is based on wheat bran at $18 per ton, corn meal at $24, middlings at $20, ground oats at $26, and cotton-seed meal at $30. The results are summarized as follows:

"The gross cost of production of live weight for the whole trial, not counting the value of weight lost by the sow, was for the Poland Chinas, 4 cents per pound; for the Durocs, 5.1, and for the Berkshires, 5.4. For the 25 weeks after removal of the sow, the Poland Chinas cost 3.91 cents per pound of gain, the Berkshires 5.13, and the Durocs 5.57; the Poland Chinas costing 23.8 per cent less than the Berkshires and 29.8 less than the Durocs. These pigs at the close of this trial ran from 116 lbs. in weight to 165, and after being used in another feeding trial were killed, when 6 Poland Chinas lost on the average by dressing 19.5 per cent of their live weight, 4 Durocs 23.7, and 4 Berkshires 25.6.

"At the high price of grain and the average price of pork, for the few years past the Poland Chinas were the only pigs to make a fairly profitable gain; but at the higher prices of pork recently prevailing, the gain made by each was a profitable one."

Feeding experiments with pigs, W. P. WHEELER (*New York State Sta. Rpt. 1892, pp. 283–285*).

Synopsis.—A comparison on 20 pigs of feeding sorghum and beets in place of part of the grain ration. The gain was in all cases slightly larger on the full grain ration. Sorghum at $2 per ton was not as economical as the larger grain ration; but beets at $3 gave a cheaper gain than sorghum or the full grain ration.

Twenty pigs, averaging about 43 lbs. each, were divided into 2 lots, and fed in 4 periods of about 1 month each. In the first period lot A had a limited amount of linseed meal and a large proportion of green sorghum (whole plant), and lot B had a full ration of linseed meal, corn meal, and a small proportion of sorghum; and in the second period the lots were reversed. In the third and fourth periods beets were fed in place of sorghum, the 2 lots being reversed as on sorghum. The full ration of sorghum was about 6½ lbs., and of beets about 5½ lbs. per animal. Skim milk was fed throughout the experiment. Data showing the amounts of food eaten and the gains in weight are tabulated for each lot. In the case of both lots the average gain per

day was larger on the full linseed-meal ration than on the rations composed largely of sorghum or beets. With sorghum at $2 per ton, beets at $3, linseed meal at $28, and corn meal at $24, "all the rations gave profitable results." The cost of food per pound of gain was slightly larger when large amounts of sorghum were fed than when only a small amount was fed; but the feeding of large amounts of beets reduced the cost between one fourth and one half cent per pound of gain.

"With beets rated at $2 per ton, as they sometimes are, the difference is still greater, and the increase in weight made at less cost per pound than is usual with the grain foods ordinarily used.

"With the sorghum rated at $1 per ton, the cost of gain made during the first period was about the same for each lot, but during the second period still somewhat greater for the lot having the large amount of sorghum."

Value of grass and exercise in the production of pork, A. A. MILLS (*Utah Sta. Bul. 28, pp. 8*).—To test these points, 5 lots of 3 pigs each were used in an experiment lasting from June 6 to October 6. Lots 1 and 2 were fed in small pens, lot 1 receiving grain and lot 2 grain and fresh grass. Lot 3 was fed grain in a movable pen in a pasture, the pen being moved three times a day. Lots 4 and 5 were allowed to run loose in the same pasture, lot 4 receiving grain and lot 5 no grain. The grain fed consisted of ground barley, ground wheat, and bran. The average results for the whole period were as follows:

Feeding and exercise experiment with pigs.

Lot.		Gain per day per pig.	Grain consumed per day per pig.	Grain consumed per lb. of gain in live weight.
		Pounds.	*Pounds.*	*Pounds.*
No. 1.	Fed grain in yard	0.90	4.35	4.82
No. 2.	....do.....and grass in yard	1.05	4.26	4.60
No. 3.	....do.....in movable pen in pasture	0.83	4.33	5.18
No. 4.	....do.....loose in pasture	1.14	4.16	3.64
	Average for the lots fed grain	0.98	4.27	4.42
No. 5.	Fed no grain loose in pasture	0.35		

"(1) Pigs allowed to roam at will over 18 acres of good pasture, and fed all the grain they would eat, made the most rapid growth, and apparently made the best use of food.

"(2) Pigs fed grass and grain in a small yard made a more rapid growth than those fed grain alone, and apparently made a slightly better use of the food eaten. . . .

"(3) Green grass appears to be of greatest value as an appetizer.

"(4) Pigs kept on grass alone made a slow growth—so slow that it would require 2 seasons for maturity—making the profits exceedingly doubtful.

"(5) Pigs kept in a movable pen on pasture ate within 7 pounds as much grain as did those in a yard without grass, but did not make as good use of it.

"(6) Exercise seems to be necessary to increase consumption and probably digestion, that growth may be rapid and economical."

Capons and caponizing, F. L. WASHBURN (*Oregon Sta. Bul. 31, pp. 89–98, figs. 7, pl. 1*).—Remarks are made on caponizing, the tools necessary for performing the operation, the preparation of capons for market, and a report on the gains in weight of 4 birds caponized at the station.

"In our estimation the Light Brahmas or the Plymouth Rocks make by far the best capons. The black Langshans are excellent also, albeit they are very slow growers. Partridge Cochins are highly spoken of. The Indian games make fine capons, as well as crosses of this species on other large breeds. A turkey was caponized here the last season, but results are not definite enough to warrant a report yet.

"As to age, many caponize as soon as they can distinguish the sex of the chick. The important point is not to wait until the glands are large and the ribs become stiff and unyielding."

The formation of fat from carbohydrates and the relation of the food to the excretion of hydrocarbons, G. KÜHN et al., reported by O. KELLNER (*Landw. Vers. Stat.*, *44*, *pp. 257–581*).—Feeding and respiration experiments are reported with mature oxen. These experiments were made in the years 1882–'84, 1885–'86, and 1889–'90. They included 4 series. In the first series meadow hay and wheat starch were fed; in the second, clover hay, oat straw, wheat starch, and wheat gluten; in the third, meadow hay and wheat starch; and in the fourth, meadow hay, ground meat from which the fat had been extracted, and wheat starch.

In an introduction the status of the question of the formation of fat from carbohydrates is reviewed, and a description is given of the methods employed in the investigation, including an illustrated description of the respiration apparatus. Owing to the extent of the investigation, only a summary of the principal results can be given here.

As in these experiments not only the digestibility of the food, but also the albuminoid exchange, and the changes in the fat in the body, were quantitatively determined, the data obtained furnish a means for judging of the maintenance ration of oxen at rest. It was found that 0.7 kg. of digestible crude protein and 6.6 kg. of digestible nitrogen-free extract per 1,000 kg. live weight was the minimum food limit to the maintenance of animals at rest. This agrees quite closely with the figures given by Henneberg and Stohmann— 0.6 kg. of digestible crude protein and 7 kg. of digestible nitrogen-free extract. When this limit was exceeded, even by the addition of less than 0.5 kg. of digestible crude protein, the animals laid on both fat and protein.

Following the period in which coarse fodder was fed alone, there were always several periods in which a productive ration was fed, brought about by adding starch, gluten, or ground meat. These productive rations, as compared with Wolff's ration for production, were very low. In spite of this the feeding of the productive rations was followed by an unmistakable effect, both in the storage of albuminoids and fat in the body and in an increased live weight.

With respect to the utilization of the digestible protein in the body the experiments verified the rule that the albuminoid supply governs the albuminoid exchange, but not the storage of albuminoids in the body. In other words, when the protein of the ration was increased by the addition of gluten or ground meat, no more albuminoids were stored in the body than when an equal amount of digestible organic matter containing only a small percentage of protein was fed.

The storage of albuminoids depended more on the amount of nitrogen-free extract in the food than on the amount of albuminoids, and owing to the albuminoid-conserving power of the carbohydrates could be continued for a long time. It follows from this that in slow fattening with a low productive ration a ratio narrower than 1:6–1:7 by no means favors the formation of flesh.

It was further found that every increase of the nutrients above the lowest amount required for maintenance was followed by a production of fat in the body, and that for this production it made no difference whether the excess of nutrients over the maintenance ration consisted of nitrogenous or nonnitrogenous materials. Laying on of fat could continue for a long time without change, and nitrogenous and nonnitrogenous materials appeared to be of like value for this purpose. Even with rations much wider than those generally considered favorable, the laying on of fat was not at all changed. Rations with a narrow ratio were less favorable to the production of fat than those with a wider ratio, although the results with the narrow ratio differed quite widely according to the kind of protein material added (wheat gluten or ground meat). Summarizing the results of 3 series of experiments, it is found that 2 oxen on a ration of 31.4 kg. of digestible organic material with a nutritive ratio of 1:4.5–1:7.2 laid on 2.049 kg. of fat; and 3 oxen on a ration of 30.52 kg. of digestible organic matter with a nutritive ratio of 1:14–1:17.4 laid on 2.138 kg. of fat. The indications from this are that under the food conditions per day and per 1,000 kg. live weight mentioned above, 0.5 or 1 kg. of digestible protein in the form of gluten could be replaced by a like amount of starch meal without any apparent change in the amount of fat produced.

The following table shows the amount of fat stored up when different amounts of digestible organic matter with different nutritive ratios were fed, the results being stated in terms of 1 day and 1,000 kg. of live weight:

Food eaten and fat stored in the body by oxen per day and per 1,000 kg. live weight.

No.	Digestible organic matter in food.	Nutritive ratio of food.	Fat stored in the body.
	Kg.		*Kg.*
1	8.72	1:18.3	0.255
2	8.95	1:19.1	0.446
3	9.12	1:14.5	0.473
4	9.35	1:15.2	0.464
5	9.36	1:14.0	0.592
6	9.47	1:14.9	0.591
7	9.54	1:12.9	0.658
8	9.60	1:14.0	0.676
9	9.97	1:7.2	0.596
10	10.06	1:15.6	0.678
11	10.09	1:7.1	0.618
12	10.85	1:17.4	0.789
13	10.98	1:4.5	0.835
14	11.18	1:20.9	1.168
Average of 1–5	9.10	....	0.446
Average of 6–10	9.73	....	0.640
Average of 11–14	10.78	....	0.852

It is plain that no storage in the body can take place except when the food contains more nutritive material than is required for the mere maintenance of the animal. The above table serves as a good illustration of this fundamental principle, and shows also that the production in the body, as far as the fat is concerned, within certain limits is proportional to the amount of nutrients in the food in excess of that required for maintenance.

An exact, constant relation between the excess of nutrients and the storage of fat can not be expected on account of the difference in the individuality of the animals. However, the above results show that, on an average, an excess of 1 kg. of digestible organic matter resulted in the formation of 0.24 kg. of fat. Since, according to this, the production of 0.446 kg. represents approximately 1.8 kg. of nutrients, it is calculated that with no increase of fat the requirement would be 7.3 kg. of digestible organic matter, which agrees with the maintenance ration mentioned above (0.7 kg. of digestible protein and 6.6 kg. of digestible nitrogen-free extract).

Considering the cases in which starch meal was added to bring the ration up to a productive ration, it is calculated that on an average the addition of 21.06 kg. of starch meal to the maintenance ration was followed by the production of 4.295 kg. of fat. In other words, 1 kg. of starch meal resulted, on an average, in the production of 0.2 kg. of fat. How much of this fat was formed directly from the starch and how much was a result of the conserving action of the starch can not be stated. It is only certain that under the above mentioned conditions, on an average, an amount of fat was produced in the body representing 34 per cent of the carbon contained in the excess of carbohydrates in the ration.

It is believed that the question as to whether carbohydrates (starch meal) can be changed to fat in the nutrition of cattle is answered in the affirmative by the results of the first 3 series of experiments.

Assuming on the one hand that the total amount of carbon in the protein was used in the formation of fat, and on the other hand that the digestible ether extract of the food was stored as fat in the body without loss, there still remains an amount of fat in the body unaccounted for, and for the production of which there is no other visible source than the carbohydrates of the food. Even if it is assumed that a portion of the carbon served for the production of glycogen, the conclusion as to the formation of fat from carbohydrates remains unchanged.

With respect to the second point, *i. e.*, the excretion of hydrocarbons by cattle, organic carbon compounds were invariably found in the gaseous excretion of all the animals, and these bore a certain relation to the total amount of carbon excreted in the gaseous products, but did not bear the regular proportion to the digestion of crude fiber that has been indicated by the experiments of Tappeiner. It is not improbable, the authors think, that the different groups of nutrients bear an unequal

part in the production of hydrocarbons. In fact, it appears that the protein can have taken only an exceedingly small part in the production of hydrocarbons. It is shown by the results not only that the digestion of cellulose in the stomach and intestines resulted in the giving off of gaseous carbon in unoxidized condition, as Tappeiner found, but also that this took place in the digestion of starch and the other nitrogen-free constituents in very nearly the same degree as in the case of cellulose. Since, according to this, the digestion of cellulose forms no exception to that of the nitrogen-free extract in general, the separation of carbon in the form of hydrocarbons in itself is believed to be no ground for considering cellulose of less nutritive value than starch and the other carbohydrates, and still less reason for questioning the nutritive value of cellulose in general.

Whether the increase in the amount of hydrocarbons given off in proportion to the increase of nitrogen-free extract in the food is a result of the fermentation by which the cellulose is dissolved, or a result of the action of other microörganisms, is a question which can not be definitely answered by experiments like the above. With the addition of starch meal to the food there was invariably an absolute increase in the excretion of hydrocarbons. There is, therefore, no ground for assuming that this increase depended indirectly on the action of the starch and was attributable to the after fermentation of a part of the cellulose which, on account of the presence of the starch, was prevented from being digested by the action of enzymes higher up in the intestines. There is more ground for connecting this increased excretion of hydrocarbons directly with the digestion of the starch.

From a review of the data obtained when starch was added to the ration, assuming that starch and cellulose have the same elementary composition and hence are of equal value for the production of hydrocarbons, it is shown that the digestion of 12,950 gm. of starch resulted in the production of 385.9 gm of carbon in the form of hydrocarbons, equivalent to 6.7 per cent of the carbon in the starch.

The results are believed to afford considerable support to the theory that the various components of the nitrogen-free extract do not differ very materially with reference to the production of hydrocarbons.

The question as to whether the fat in the food yields hydrocarbons in its changes in the intestines could not be determined in this investigation, since the rations fed were purposely made poor in fat and the amount of digested fat was so small that its influence on the production of hydrocarbons, if any, was too slight to be studied.

Formation of glycogen in the animal body after consuming xylose, J. FRENTZEL (*Pflüger's Arch. Physiol., 56, No. 6 and 7, pp. 273–288*).—The experiments of Cremer[1] and Salkowski[2] had indicated that xylose and arabinose favored the formation of glycogen when fed

[1] Ztschr. Biol., 29, p. 484.

[2] Centbl. med. Wiss., 1893, No. 11.

to rabbits and hens. The author studied the effect of xylose in this connection, using rabbits. The subjects were rendered glycogen-free by strychnine, given a narcotic to keep them quiet, and killed 11 or 12 hours after feeding the xylose. Doses of 3.75, 8, and 10 gm. of xylose were given. No glycogen formation was observed in these experiments, and the author believes that they show that xylose is not capable of forming in the body glycogen or other substance giving the reactions of glycogen. He believes further that xylose does not indirectly promote the formation of glycogen, as by a conserving action on other substances (albumen) known to produce glycogen directly.

Fodder analysis, G. L. TELLER (*Arkansas Sta. Rpt. 1893, pp. 111–119*).—A popular explanation of terms used in reporting the analyses of feeding stuffs is given, with analyses of a number of kinds of hay from the Memphis market, reprinted from Bulletin 24 of the station (E. S. R., 5, p. 500).

Fruits as food for animals, C. CORNEVIN (*Ann. Agron., 20 (1894), No. 5, pp. 209–228*).

Leaves and twigs as fodders (*Centbl. Forstwesen, 20 (1894), No. 5, pp. 224, 225*).

The value of rape-seed cakes for improving the quality of winter butter (*Nord. Mejeri Tidn., 9 (1894), p. 164*).

Rape seed vs. rape-seed cake, A. ELTEN (*Landmandsblade, 27 (1894), pp. 167, 168*).

Effect of feeding potato vines on the milk and its products (*Abs. in Molk. Ztg., 8 (1894), No. 19, p. 274*).—An experiment indicated that feeding cows exclusively on potato vines did not affect the composition of the milk, but did affect its behavior towards rennet, injuring the milk for cheese-making.

Record of the dairy herd at the Aas Agricultural College (Norway), T. KOLLER.—This report gives the total milk yield and the food eaten by the herd from July 1, 1891, to June 30, 1892. The herd consisted of 129 head of cattle, 105 of which were milch cows and heifers. The cows were partly imported Ayrshires, partly improved Telemark crosses, and Gudbrandsdal, and partly crosses of Ayrshire and Telemark breeds.

The average milk yields for the cows of the various breeds and of the cross breeds for the year were as follows:

Average milk yield of cows.

	Number of cows.	Live weight.			Milk yield.		
		Highest.	Lowest.	Mean.	Highest.	Lowest.	Average.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Imported Ayrshire	14	1,157	728	882	6,777	4,038	4,797
Ayrshire—Telemark cross	10	1,036	750	913	7,173	4,089	4,920
Telemark	5	893	761	840	5,897	3,765	4,913
Gudbrandsdal	3	761	716	754	4,509	4,036	4,201

Annual milk yield of dairy herd at Danvik (Norway) (*Norsk Landmandsblad, 1894, No. 13, pp. 45, 46*).—The herd consisted of 59 milch cows of the Ayrshire breed crossed with the pure Telemark breed. The average live weight of the cows was 950 lbs. The average yield of milk for the herd was 6,403 lbs. during 1891, 6,162 during 1892, and 6,320 during 1893.

The average time of gestation for the cows was 281⅗ days in 1889, 281⅘ in 1890, 281½ in 1891, and 279 in 1892.

A feeding experiment with pigs (*Abs. in Molk. Ztg., 8 (1894), No. 22, p. 324*).—Experiments made at the Dairy Institute at Proskau in feeding skim milk, potatoes, and whole, ground, and cooked barley.

Feeding experiments with capons, W. P. WHEELER (*New York State Sta. Rpt. 1892, pp. 236–270, pls. 5.*)—A reprint of Bulletin 53 of the station (E. S. R., 4, p. 938).

Feeding experiments with laying hens, W. P. WHEELER (*New York State Sta. Rpt. 1892, pp. 270–283*).—A reprint of Bulletin 57 of the station (E. S. R., 5, p. 201).

Does there exist a digestion of albuminoid substances without digestive ferments? A. BÉCHAMP (*Compt. Rend., 118 (1894), No. 21, pp. 1157–1160*).—Principally a discussion of the question whether albuminoid substances subjected to the action of antiseptic saline solutions undergo transformations similar to those due to gastric and pancreatic digestion as claimed by A. Draste.

What kind of sugars result from the dissociation of starch and glycogen by animal ferments? E. KÜLZ and J. VOGEL (*Ztschr. Biol., 31, pp. 108–124; abs. in Chem. Centbl., 1894, I, No. 21, p. 1004*).

Further observations on the effect on the metabolism of the dog of taking the daily ration in one or several portions, C. ADRIAN (*Ztschr. physiol. Chem., 19, No. 2, pp. 123–136*).

On the pathology of the metabolism of lime, V. NORDEN and K. BELGARDT (*Berl. klin. Wochenschr., 31, pp. 235–238; abs. in Chem. Centbl., 1894, I, No. 21, p. 1005*).

VETERINARY SCIENCE.

Tuberculosis in relation to animal industry and public health, J. LAW (*New York Cornell Sta. Bul. 65, pp. 105–157*).—The subjects discussed are the prevalence of tuberculosis in man and in the lower animals, the contagious nature of the disease, the tubercle bacillus, accessory causes favorable to the development of tuberculosis, lesions and symptoms of the disease in its various forms, the value of tuberculin as a test and a reply to the objections made against its use, the danger of transmitting tuberculosis to man and the lower animals through the consumption of tuberculous meat and milk, a lengthy discussion of poisoning by ptomaines and toxins in the meat and milk of tuberculous animals, preventive measures for stockmen and for the State, and a discussion of the laws of New York State bearing on tuberculosis.

Accurate statistics giving the percentage of tuberculous animals in American herds are wanting, but figures from other countries are quoted. "In infected breeding and dairy herds in New York, consisting largely of mature cows, I have found a maximum of 98 per cent and a minimum of 5 per cent. Again in healthy country districts I have found hundreds of cows in adjoining herds without a trace of tuberculosis among them." The tubercle bacillus is killed by a temperature of 158° F. for 10 minutes. "It dies in a few hours in direct sunlight and in 5 to 7 days in diffuse daylight. In an ordinary room it gradually weakens, but remains virulent for at least 2½ months. . . .

"Galtier found that the bacillus tuberculosis was preserved indefinitely in springs, ponds, and wells at all ordinary temperatures. Hence the danger of common drinking troughs, of streams that have run past infected herds, or the places where their manure has been put, and of soil that has received the manure or carcasses of the diseased."

Among the accessory causes which promote the development of tuberculosis primarily caused by the bacillus are hereditary predisposition, lack of ventilation, dark stables, insufficient or unwholesome food, overtaxing the system, breeding too young, inbreeding, general ill health, and chemical poisons in the tuberculous body. Experiments recorded by Johne showed that 13 per cent of the animals to which tuberculous products were fed became tuberculous. The results were variable, the conditions governing the spread of the disease being (1) the relative susceptibility of the various animals experimented on, (2) the condition of the digestive organs at the time of feeding, (3) the animal from which the germ was derived, (4) the degree of infection of the material fed.

"It would seem as if the muscle or red flesh in cattle were antagonistic to the bacillus tuberculosis. Certain it is that tubercles are rare in the substance of the muscle. They are, however, very common in the lymphatic glands lying between the muscles, and in swine they are common in the substance even of the red flesh. The flesh of tuberculous pigs is therefore far more dangerous than is that of consumptive cattle. Even in tuberculous cattle, however, the beef is not always free from bacilli. . . .

"Milk is more to be dreaded than meat, because the udder is often the seat of tuberculosis, and the milk is usually taken uncooked."

Some of the authorities quoted obtained tuberculosis by inoculating animals with the milk of tuberculous cows having udders apparently sound, while others failed to obtain tuberculosis by experimental inoculation from similar animals. The author takes the position that whether the milk from tuberculous animals having udders free from tuberculosis is infected or not, it can not be safely used, and cites experiments by Hirschberger, Bang, Ernst, Smith, and Kilborne in support of this proposition.

"In my own experience 3 calves, from healthy parents, sucking the apparently sound udders of 3 cows with general tuberculosis all contracted the disease."

Several instances are given in support of the proposition that tuberculosis has been conveyed to human beings through drinking uncooked milk, and to show the identity of tuberculosis in cattle and in man.

The essentially new portion of the bulletin is the discussion of poisoning by ptomaines and toxins in the milk and meat of tuberculous animals, a subject which, the author states, has been overlooked heretofore. The author's position is that the tubercle bacillus is not the only injurious agency in tuberculous food products, but that the ptomaines and toxins occurring there are also injurious to those already suffering from tuberculosis even in its mildest stages. In the same manner that tuberculin hastens the tubercular process in diseased animals submitted to the test, so these chemical poisons would hasten the same process in the persons consuming tuberculous products.

"Accepting as undeniable the presence of the soluble chemical poisons in blood, flesh, and milk, it follows that those who eat this flesh or milk are continually taking in small doses of tuberculin, and that in case they are already the victims of tuberculosis, in however slight or indolent a form, this continuous accession of

the poison will rouse the morbid process into greater activity and secure a dangerous extension.

"If we now consider the frightful prevalence of tuberculosis in the human race, that here in New York every eighth person dies of tuberculosis, that in cities like Vienna 85 per cent of the people suffer from it, and that in our own cities 30 to 50 per cent contract it at some period of life, we see what a fearful risk is being run by the utilization of the meat and milk of animals so affected, even if it could be shown that such meat and milk were in themselves free from the living bacillus."

The preventive measures which stockmen are advised by the author to adopt are the following:

"(1) Board up the partitions of the stalls at the front so that no 2 cows can feed from the same manger or lick each other.

"(2) Keep each animal strictly by its own stall and manger.

"(3) When any animal is suspected don't let it use a drinking trough or bucket in common with other animals.

"(4) Avoid old milch cows and unthrifty ones, or keep them secluded from the rest of the herd.

"(5) The following conformation usually indicates a weakness of constitution and a susceptibility to tuberculosis: Head narrow between the horns, sunken eyes, depth of cavity (temporal) back of the eyes, thin, narrow, ewe neck, chest small, lacking in both depth and breadth, hollow flank and tendency to pot belly, a general lack of muscle so that the limbs seem loosely attached to the body; in breeds that show a variety of colors, animals of the lighter shades of brown and yellow. If, however, such animals are of high value for the dairy, and can be kept free from infection, they need not be rejected. . . .

"(6) Don't purchase from a herd in which tuberculosis has appeared or in which cattle have died or been killed within a year or two. Resort first to the tuberculin test.

"(7) Don't take a cow with a husky or rattling cough, wheezing, hurried breathing, discharge from nose, fetid breath, hard bunches under the skin, diseased udder, swollen bones or joints, unthriftiness, or a tendency to scour or bloat.

"(8) Don't purchase from city, suburban, or swill stables.

"(9) Don't add newly purchased cattle to your herd until you have tested them with tuberculin, especially if they have been the product of inbreeding.

"(10) Don't admit strange cattle to house, field, or yard with your own; keep them apart until tested with tuberculin.

"(11) In case of disease or unthriftiness in your herd, put the animal apart and have it examined by a skillful veterinarian.

"(12) If after this there remains any doubt as to the real nature of the disease, have the animal tested with the tuberculin, in the hands of a practitioner thoroughly acquainted with cattle and their diseases. If the result is not yet quite clear, keep the animal by itself and repeat the test in 4 weeks.

"(13) In case an animal in a herd shows tuberculosis test the whole herd with tuberculin.

"(14) Test in the same manner all animals on the farm (swine, goats, sheep, horses, rabbits, cats, dogs, fowls) that cohabit with the cattle.

"(15) Kill all tuberculous animals and boil, burn, dissolve in acid, or bury deeply in a place to which no animals have access.

"(16) Disinfect premises thoroughly, also all products of the diseased animals and all articles used about them.

"(17) Let no consumptive person attend on cattle or other live stock, or prepare their food.

"(18) Vermin (rats, mice, sparrows) in a building where tuberculous animals have been should be exterminated."

Report on tuberculosis in Ontario, P. H. BRYCE.—This report, presented to the Provincial Board of Health of Ontario, Canada, contains statistics regarding the prevalence of human and bovine tuberculosis in different parts of the world with special reference to the Province of Ontario, and a discussion of the methods by which infection occurs, and of precautionary measures to prevent the spread of tuberculosis. Among the conclusions drawn are the following:

"In cattle, while the bacilli are probably always present in the milk when the udder is tubercular, yet the bacilli may be present in the milk in a considerable percentage of cases where even *post-mortem* examination reveals no tubercles of the udder. . . .

"[Natural] inoculation is dependent upon the extent and frequency of the passage of infective materials into either [the alimentary or respiratory] tract, and largely upon the receptive condition of the mucous membrane in both cases. A healthy mucous membrane offers much resistance to the passage of bacilli. . . . The great proportion of cases of tuberculosis are the results of aërial infection by way of the respiratory tract.

"While the great number of deaths from tuberculosis in children, as from *tabes mesenterica*, or consumption of the bowels, points to the probability of frequent cases of infection through milk and other food by way of the alimentary tract; yet the still larger number of cases of lung tuberculosis in children, the relatively small number of calves and young cattle infected with tuberculosis, and the comparatively few instances of tuberculous cattle in which the intestines, mesentery, or other abdominal organs are found on examination to be exclusively tubercular, point very strongly to the conclusion that infection by way of the intestines is relatively seldom in cattle, and that where it does take place in children it most probably is dependent on the previously unhealthy and congested state of the mucous membrane of the walls of the stomach and of the intestines."

Practical results of inoculation against charbon and rouget in France, C. CHAMBERLAND (*Ann. Inst. Pasteur, (1894), No. 8, pp. 160–165*).—Reports on 1,788,677 sheep and 200,962 cattle inoculated for charbon show that the losses resulting from this operation during the first year amount to only 0.94 per cent with sheep, whereas before inoculation the losses from charbon are estimated at 10 per cent. With cattle the losses during the same time after inoculation averaged only 0.34 per cent, while the losses before vaccination amounted to 5 per cent.

Of 111,437 hogs inoculated against rouget the losses during the first year resulting from the operation averaged 1.45 per cent, while before inoculation the loss was 20 per cent.

Investigations on the genus Actinomyces, G. GASPERINI (*Centbl. Bakt. u. Par., 15 (1894), No. 18, pp. 684–686*).

Recent investigations on the diagnostic and remedial value of mallein in glanders, A. BONOME (*Centbl. Bakt. u. Par., 15 (1894), No. 18, pp. 686, 687*).

Tuberculosis in farm animals, P. A. MÖRKEBERG (*Copenhagen: 1894*).

The diagnosis of tuberculosis, S. BERNHEIM (*Abs. in Centbl. Bakt. u. Par., 15 (1894), No. 17, pp 655–666*).

Tests of cattle with tuberculin, NOCARD (*Ann. d'Hyg. publique, 1894, Jan., p. 21; abs. in Milch. Ztg., 23 (1894), No. 21, p. 333*).

The treatment of tuberculosis with sterile serum, S. BERNHEIM (*Abs. in Centbl. Bakt. u. Par., 15 (1894), No. 17, pp. 654, 655*).

Treatment of the skim milk returned to creamery patrons during the prevalence of mouth-and-foot disease, P. VIETH (*Molk. Ztg., 8 (1894), No. 21, pp. 305, 306; and Milch Ztg., 23 (1894), No. 21, pp. 329, 330*).—Recommends that it be heated to 90° C. or in a high-pressure sterilizing apparatus to 100° C. to prevent infection.

Texas fever, A. T. NEALE (*Delaware Sta. Bul. 23, pp. 11*).—A condensed reprint of the proclamation of the Secretary of Agriculture regarding this disease, a record of instances in which Texas fever has been introduced into the State by animals brought from the infected district, a comparison between the laws of Delaware and of Kansas relating to the responsibility of drovers for losses incurred by Texas fever, and a statement that the Delaware law on this point requires amendment.

Parasitism of domestic animals, R. R. DINWIDDIE (*Arkansas Sta. Rpt. 1893, pp. 3-31*).—A reprint of Bulletin 20 of the station (E. S. R., 4, p. 749).

DAIRYING.

Composition of milk in successive periods of lactation, P. COLLIER (*New York State Sta. Rpt. 1892, pp. 138–140*).—The average yield and composition of the milk of all the cows in the test of breeds in the first, second, and a part of the third, periods of lactation, are tabulated.

"During the first months of the second period of lactation the milk yield is very considerably in excess of the yield for the same months of the first period, [but] gradually this excess disappears, so that after the seventh month the average yield of milk becomes much less even than it was during the latter months of the first period. The same is true as to the amount of total solids, while the percentage of total solids during the entire second period is a little more than during the first period, but remains nearly constant during the entire period.

"The percentage of fat in the milk of the second period is at first 4 or 5 per cent less than during the first period, but during the fourth, fifth, and sixth months equals the percentage for the same months of the first period, but again falls off in the latter months of the second period.

"The total amount of fat and of casein of the second period follows closely the changes in milk yield. The percentage of casein, at the first about 95 per cent of what it was during the first parts of the first period, gradually increased until during the ninth and tenth months it is 10 per cent above what it was at the same time in the first period.

"The sugar is 10 to 12 per cent greater during the early months of the second period than during these early months of the first, but diminishes slowly during lactation."

Changes in the relative size of milk globules in successive periods of lactation, and in the actual number of globules during lactation, P. COLLIER (*New York State Sta. Rpt. 1892, pp. 153–162*).—Observations are given on the size of the globules in the milk of different breeds in the first, second, and a part of the third periods.

"There is, as a general rule, a steady increase in the number of the smaller globules and a decrease in the larger globules during successive periods of lactation. . . . The smaller globules below 1 on the micrometer scale have increased 68 per cent in the second period over what they were in the first; the largest globules (from 4 to 6 upon the scale) have decreased during the second period 67 per cent of their number during the first period; while the intermediate globules during the second

period (from 1 to 4 upon the scale) have fallen to 83 per cent of their number during the first period. A similar change is seen to have taken place when comparing the globules of the second period with those of the third period."

The actual number of fat globules in the milk was found to increase in the first period as lactation advanced, and this result was corroborated in the second period.

"The number of globules increases very steadily from the first to the last month, the increase being quite 150 per cent, although the difference in this increase is very marked between the several breeds, as, for example, the Jerseys and Guernseys as compared with the Ayrshires and Holstein-Friesians."

Activity of the physiological processes (p. 162).—"The average yield for the 23 cows under experiment those mornings when the milk samples taken for microscopic analysis was 9.39 lbs. per cow, or 0.7826 lb. per hour for the 12 hours before milking. The average number of globules counted in 536 counts was 144.6 for each 0.0001 cmm., and this shows the average secretion of 138,210,000 globules per cow per second, a result remarkably in accord with that obtained previously."

Examination of cheese made from goats' milk, F. H. WERENSKIOLD (*Rpt. Chem. Control Sta. Christiania, 1893, pp. 7–10, 43*).—Eight samples of cheese made from goats' milk were analyzed, with the results given in the table below. The last 3 samples in the table were known to be pure, no cows' milk having been added in its manufacture. The others were exhibited as goats' cheese at the Stavanger Dairy Exposition in 1893, and were supposed to be unadulterated.

Analyses of goats' cheese.

No.	Water.	Ash.	Fat.	Protein.	Other substances.	Protein in solids-not-fat.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
1	15.53	5.14	32.68	10.63	46.02	17.02
2	20.16	5.90	24.40	10.50	39.04	18.90
3	17.60	6.31	22.00	6.31	47.78	10.45
4	26.53	6.41	14.93	9.44	42.69	16.10
5	17.66	5.78	20.93	8.94	46.68	14.60
6	24.51	6.57	16.75	5.39	46.78	9.20
7	20.67	5.91	10.98	4.43	58.07	8.64
8	24.56	6.46	16.23	5.34	47.41	9.00

No lactic acid was found in any of the samples. The cheese is prepared by evaporating to dryness partially skimmed goats' milk, new milk, or sometimes cream being added later during the boiling. The cheese is also manufactured from whey, with the addition of new milk or cream. A sample of "white goat cheese" prepared from goats' milk, with the addition of rennet, had the following composition: Water 37.14 per cent, ash 3.95, fat 22.69, protein 30.94, other substances 5.58, protein in solids-not-fat 77.0.—F. W. WOLL.

Analysis of cheese made from reindeers' milk, F. H. WERENSKIOLD (*Rpt. Chem. Control Sta. Christiania, 1893, p. 10*).—A sample of cheese made from reindeers' milk, obtained by the author from Vefsen, Norway, had the following composition: Water 27.70 per cent, ash 2.43, fat 43.11, protein 23.79, other substances 2.97. The cheese was

round and flat, about 10 in. in diameter and 5 in. high. After having been kept in a basement curing room for about six weeks, the cheese had a sharp odor somewhat resembling that of Roquefort cheese.—F. W. WOLL.

Comparison of deep-setting and centrifugal methods of creaming milk, L. L. VAN SLYKE (*New York State Sta. Rpt. 1892, p. 469*).—In a comparison of Ayrshire, Devon, Guernsey, Holderness, and Jersey breeds of cows, trials were made during the first period of lactation in raising the cream by deep-setting, and by means of the hand separator. A summary, by breeds, for the first period of lactation is tabulated.

"The results show that, in the case of every breed, the separator gives better results in yield of butter. The increased yield was greatest with the Holsteins and second with the Ayrshires. According to the above results, a herd of 6 or 7 Holsteins would, with a separator, make an increased yield of butter in 1 year sufficient to pay for a separator, while a herd of 12 Ayrshires, 16 Devons, 18 Holderness or Jerseys, or 24 Guernseys would do the same."

An acid test of cream, E. H. FARRINGTON (*Illinois Sta. Bul. 32, pp. 389–394*).—For conveniently testing the acidity of cream in ripening it, the author proposes to use alkaline tablets containing a definite amount of solid alkali and indicator. From his formula, tablets have been made by a manufacturing chemist and placed upon the market. Each tablet is equivalent to 4.66 cc. of decinormal alkali in neutralizing power. The tablets are dissolved in water and added to 25 cc. of the cream until the indicator gives a permanent color.

"The indications are that a cream which requires a solution of 6 or more tablets to change its color is too sour. The butter made from such cream will be 'off flavor.' The only general direction that can now be given as applicable to nearly all cream is to churn it when 25 cc. of the thoroughly mixed cream is not colored by a solution of 4 tablets, but is decidely colored by a solution of 5 tablets.

"Some dairymen may prefer to churn a less acid cream and adopt the sourness of cream which will give a color with a solution of 3 tablets.

"Comparative trials made by each person of the acidity of the cream and the flavor of the butter made from it will be a satisfactory guide to follow."

A milk fault and its cause, W. THÖRNER (*Chem. Ztg., 18 (1894), No. 33, pp. 607–609*).—During the summer the milk of one of the patrons of a creamery developed a very disagreeable odor which was transmitted to the butter, often making it unsalable. Previously the butter made from this milk had been of good quality. The author visited the farm of the patron and took samples of the milk of different cows from the first and last portions of the milking, and of the well and brook water which the cows drank. The herd was at the time on good pasturage and the stable and surroundings were clean and favorable. Cultures were made and studied from the samples taken. Nearly every sample of milk contained an organism having the appearance of a mold, and where this was present a putrid odor was noticeable. Pure cultures were made of the supposed mold and all the forms of bacteria present, and these verified the suspicion that the mold alone was the

cause of the odor. Samples of milk were inoculated with the mold culture and placed in the sunshine, in indirect sunlight, and in the culture oven. The milk placed in the sunshine developed the putrid odor in about an hour, and that in indirect sunlight somewhat later, while the samples in the culture oven, *i. e.*, in the dark, developed only a slight odor after a long time. The odor was found to be due to a volatile ammoniacal compound. Under conditions favorable to the rapid growth of lactic acid bacteria, the compound would soon be neutralized by the lactic acid produced, which is believed to explain the weak development of odor in the culture oven. The author concludes that the mold-like microörganism was the real cause of the odor, and he describes its growth and characteristics. It was aërobic and grew rapidly at a temperature of 20–30° C., covering the gelatin plate with a thick growth of grayish white mold without liquefying the gelatin. On examination with a high power, it was found to be a bacillus, the separate cells being arranged so as to present the appearance of a fungus growth, while having no connection with one another. The author suggests that it may be identical with *Bacillus fœtidus lactis*, which Jensen and Lunde found to be the cause of a putrid odor in milk and butter.

Directions were given for thoroughly disinfecting the dairy utensils, the cows' udders, and the stable. The creamery reported, however, that the objectionable feature of the milk did not disappear directly, and the author is in some doubt as to whether his directions were thoroughly executed.

Rich and poor milk, N. DAHL (*Landmandsblade, 27 (1894), pp. 282–286, 299, 300*).

Abnormal composition of human milk, A. STIFT (*Forschungsber. ü. Lebensmtl., 1, pp. 173–175; abs. in Chem. Centbl., 1894, I, No. 21, p. 1004*).—The milk nine months after birth has a neutral reaction and a fat content of 8.03 per cent.

Milk as the source of an epidemic of typhoid fever, P. SCHMIDT (*Inaugural Dissertation, Halle; abs. in Milch Ztg., 23 (1894), No. 21, p. 330*).

The preservation of milk in Copenhagen, ST. FRIIS (*Ztschr. Fleisch- u. Milchhyg., 4 (1894), No. 7, pp. 128–131*).—Methods of managing cows and milk, including the pasteurization of the latter.

Babcock's test for the determination of fat in milk, (*Finnish Tidning för Mjölkhushållning.*)—This test was recently investigated before the officials of the Imperial Agricultural Society of Finland and several dairy experts, and gave general satisfaction. The results obtained by the method came nearer the chemical analysis than the lactocrite. It was the general opinion that if introduced into Finland the test would be epoch-making for their dairy and creamery industry.

Fat determination by Babcock's method, F. H. WERENSKIOLD (*Rpt. Chem. Control Sta. Christiania, 1893, pp. 62, 63*).

The detection of milk adulteration by comparison with samples taken at the barn, J. HERZ (*Rev. Internat. Falsif., 7, pp. 130–132; abs. in Chem. Centbl., 1894, I, No. 20, p. 976*).

Regulations controlling the sale of margarin and other butter substitutes in Jersey.—A 10-page pamphlet giving the text of regulations passed the "States" or insular Parliament, February 22, 1894.

Should the farmer supply his farm with a hand cream separator or send his milk to a coöperative creamery of which he is a member? (*Jour. Assoc. Anc. Élèv. Gembloux, 7 (1894), No. 9, pp. 304–311*).

Souring of cream by means of pure cultures, N. ENGSTRÖM (*Nord. Mejeri Tidn., 9 (1894), pp. 221, 222, 233.*)

Finnish exports of butter to England (*Tidn. Mjölkhushållning, 3 (1894), p. 74*).

Important questions for creameries and patrons, V. MELANDER (*Stockholm: 1894*).

Experiments made in the manufacture of cheese during the season of 1892, L. L. VAN SLYKE (*New York State Sta. Rpt. 1892, pp. 299–467*).—A summary of the experiments of the season reprinted from Bulletin 50 of the station (E. S. R., 4, p. 945).

The bacteriology of cheese-making, P. HELLSTRÖM (*Nord. Mejeri Tidn., 9 (1894), pp. 185, 197, 198, 209, 210*).

Concerning a new method of preventing the green coloration of cheese, G. SARTORI (*Staz. Sper. Agr. Ital., 26 (1894), No. 3, pp. 265–269*).—An account of the author's experiments in which copper vessels, bright or tarnished, and tinned iron vessels were used.

Manufacture of skim-milk cheese (*Tidn. Mjölkhushållning, 3 (1894), p. 74.*

Cheshire cheese, C. M. BLADES (*Analyst, 1894, June, pp. 131–133*).

Analysis of cheese from centrifugalized milk, L. CARCANO (*Annuario della R. Staz. Sper. Caseificio in Lodi, 1892, pp. 84–87*).

The more important experiments in dairying at the experiment stations in North America, M. WILCKENS (*Molk. Ztg., 8 (1894), No. 19, pp. 273, 274; No. 21, pp. 305, 306, and No. 22, pp. 321–323*).—Brief accounts of dairy investigations at the Delaware, Indiana, Iowa, New York State and Cornell, Pennsylvania, and Vermont Stations and the Ontario Agricultural College and Experimental Farm.

Dairy schools and dairy products, F. W. WOLL (*Pop. Sci. Monthly, 1894, June, pp. 234–243*).

AGRICULTURAL ENGINEERING.

Pumping water for irrigation in southwestern Arizona, F. A. GULLEY and C. B. COLLINGWOOD (*Arizona Sta. Bul. 11, pp. 17–24*).—This is an account of experiments near Yuma, Arizona, to test the economy of pumping water from the Colorado River up to a mesa 80 ft. above its level to be used in the culture of "tender and early fruits and vegetables."

A company has put in a plant which purposes to deliver water on this mesa "at the rate of $12 per annum per acre for 2½ acre-feet. . . . This is at the rate of 20 cts. per day for 1 miner's inch of water."

"At first glance, elevating water 80 feet to be used for irrigation purposes in a climate as dry as that of Yuma may seem too costly to be profitable, and it perhaps would for growing ordinary farm crops, but the mesa soils of southwestern Arizona, when irrigated, will produce crops of the highest value per acre, owing to their being exempt from injurious frosts.

"From the tests made last winter and this, we find that peas and strawberries may be ripened at any time during the winter or spring, the main crop of the latter being ready to ship the latter part of March.

"Asparagus is ready for market February 25, wax beans and summer squash April 15, and tomatoes May 15 to 25.

"In the town and valley near by the early varieties of grapes begin to ripen June

5, Pringle apricots May 1, and Royal apricots May 15, figs May 1, Alexander peaches May 15, lemons, limes, and dates October 15, and Navel oranges November 20.

"The climate appears to be especially suited to the production of citrus fruits, especially lemons and limes, which thrive particularly well, the temperature never falling low enough to injure them.

"The almost constant bright sunshine during the daytime and the dry atmosphere during the winter and spring months give to early fruits and vegetables a superior quality that can not be equaled under the less favorable conditions in a more moist climate during the maturing period, and it also insures better shipping and keeping qualities.

"The high prices the early products of this place command in the Eastern and Western markets and the success with which they have been grown were the leading inducements that led to this bold experiment in irrigation engineering.

"An abundant water supply is assured for all lands that may be reached from the Colorado River; and in addition to this the water carries a considerable quantity of fertilizing matter in solution and in suspension, the value of which, when applied to land used for fruit and vegetable growing, will, to quite an extent, offset the expenditure for pumping.

"[Analyses of this water are given which show that the] fertilizing value of 2½ acre-feet water is $8.55, which is two thirds of the cost of the water at 20 cts. per miner's inch.

"In addition to the foregoing, the water carries with it a good deal of clay, which, with the other materials, will gradually change the sandy mesa lands to a rich sandy loam where it is used for irrigation.

"[The success of these and other enterprises in the same line having] demonstrated that the water of the Colorado River may be used on the high mesas as well as on the lower lands, the investment of capital to reclaim a large area of territory will not be difficult to secure."

Irrigation experiments, J. W. SANBORN (*Utah Sta. Bul. 27, pp. 8*).

Synopsis.—The results of irrigating wheat at different dates from May 13 to August 3, although not conclusive, indicate that early and late irrigation increase the yield of grain at the expense of straw. In case of oats and potatoes early irrigation (May 11 to July 25) produced a smaller yield than usual irrigation (June 1 to July 7). Tests of methods of irrigation were not entirely satisfactory, but the results favor flooding and bed work irrigation.

This is a continuation of experiments begun in 1890 and previously reported in Bulletin 23 of the station (E. S. R., 5, p. 215). Comparative tests were made in 1893 of (1) early (May 13 to June 25), late (July 2 to August 3), and usual (June 20 to July 25) irrigation on wheat; (2) early (May 11 to July 25) and usual (June 1 to July 7) on wheat, oats, and potatoes; and (3) methods of irrigation.

Early, late, and usual irrigation on wheat.—The results during 4 years are tabulated and show "a decided gain by early and late watering, and that this gain accrued to the seed more than to the stem and straw. . . . The 'not watered' plats adjacent to the watered plats gave but 4.5 bus. per acre, showing that the lateral flow of water under ordinary irrigation amounts to practically nothing, for plats without irrigation generally produce about that amount of wheat per acre."

Early and usual irrigation on wheat, oats, and potatoes.—The yields of wheat and oats in grain and straw during 4 years and of potatoes during 1 year are reported. "A review of the [results] shows that the early watering gave an increase of wheat and a decrease of straw.

In this respect it differs from the results in the other trial." This was thought to be due to the fact that watering when the grain was being formed lowered the temperature of the air and soil, checked the vegetative processes, and promoted seed formation.

"The influence of early *vs.* usual watering on oats is different from its influence on wheat. The early watering each succeeding year decreased both the grain and the straw, except in 1892, when the straw was greater for the early watering. The philosophy of this result is not clear.

"The potato crop suffered very materially from early watering. This crop is not usually planted as early as wheat is sown, and the presumption is that the influence of watering before the necessities of the plant demanded water, through a reduction of the temperature of the soil and the air around the leaf became partially equivalent to turning the season back, so far as the question of temperature is concerned. Experiments have shown that excess of water has an injurious effect on the plant."

Methods of irrigating.—Under this head is reported the influence on the yield of oats in 1891 and of hay in 1892, and 1893, on plats 2 by 6 rods, of irrigating by (1) flooding from one side, (2) laterals running from one side, (3) flooding from the end, (4) flooding by surrounding the plat by a bank and simply inundating it, and (5) by bed work, *i. e.*, by rounding up the plat to the center and running through it a ditch so adjusted as to depth or width that the water will overflow throughout its entire length.

"Plats 2 by 6 rods are too small to make a critical experiment on a question of the kind.

"The experiment with oats covered but 1 year, 1891, and must be regarded as inconclusive. However, it favors the system of flooding and of bed work. The crops of 1892 and 1893 are not in agreement as to the advantages to be derived from an equal distribution of water over the plat."

Experimental farming in Utah, J. W. SANBORN (*Irrigation Age, 1894, June*).

Simple earthern dams for irrigation reservoirs, S. FORTIER (*Irrigation Age, 1894, June*).

STATISTICS.

Report of director and of treasurer of Arkansas Station (*Arkansas Sta. Rpt. 1893, pp. 1, 2, VI*).—Brief remarks on the work of the year, the condition of the station, a list of the bulletins published during the year, and a financial report for the fiscal year ending June 30, 1893.

Report of director and of treasurer of New York State Station (*New York State Sta. Rpt. 1892, pp. 5–234*).—This includes a list of the bulletins published during the year, an article on what the station is doing for the farmer, a brief review of the work of the different departments during the year, a list of acknowledgments, articles on the investigations of dairy breeds, changes taking place in the silo, analyses of fruit trees and commercial fertilizers, noticed under the appropriate headings, and a financial report.

List of publications of the United States Department of Agriculture, 1889–'93 (*pp. 42*).

Report of the statistician (*U. S. Dept. Agr., Division of Statistics, Rpt. 115, n. ser., May, 1894, pp. 220–294*).—The subjects discussed are temperature and rainfall; condition of winter grain; changes in crop area; the world's supply and consumption of cotton; fruit crop prospects in the United States, May 1, 1894; agricultural production of Mexico for 1889 and 1892; agricultural statistics of Uruguay; Austrian cereal crops for 1893; Japanese cereal crops for 1893; European crop report; notes from United States consular officers; and transportation rates.

NOTES.

ARIZONA COLLEGE AND STATION.—T. B. Comstock, who for the past year has been president of the university faculty, was elected president of the university and given the executive control of all departments thereof on May 30, 1894. The experiment station has been reorganized by the formation of a council, with Dr. Comstock as president. F. A. Gulley, director of the station, C. B. Collingwood, chemist, and J. A. Heberly, assistant chemist, have resigned. The appointment of chemist will be made at an early date, the position of agriculturist and horticulturist remaining vacant for the present, with the president of the council temporarily acting in that capacity.

CONNECTICUT STATION.—The station has just built a small glass house for vegetation experiments with fertilizers.

IDAHO STATION.—The director is conducting a series of experiments with about 560 varieties of economic plants, including cereals, forage and fiber plants, sorghum, orchard and small fruits, vegetables, tannin plants, and forest trees.

INDIANA STATION.—J. M. Barrett has been appointed assistant chemist of the station. W. G. Wright, assistant botanist, has resigned, and William Stuart has been appointed in his place.

MINNESOTA STATION.—O. Lugger has started an extensive experiment with chinch-bug diseases throughout a large affected area of the State. M. H. Reynolds is doing considerable work with tuberculin and will have an extensive report later. One or more substations for crop work are being organized by Prof. Hays. T. A. Hoverstad, the first graduate of the six-year course of study under the reorganization of the College of Agriculture in the University of Minnesota, has been retained as an assistant in the experiment station. Several members of the experiment station corps are teaching in the girls' agricultural school recently instituted. Dairying, cooking, gardening, domestic economy, and similar lines are taught by lectures. In cooking a· d dairying practice will be given. Applications to the full capacity of the school are already in.

TEXAS STATION.—Since the first of the year the station has published "press notes" for the benefit of the county papers of the State. These give a plain account of some of the experiments, and correspondence of instructive character. Two issues have been published. Encouragement comes from many parts of the State in this work; some 200 papers are using this matter, and by this means it is hoped to reach the farmers who do not read agricultural papers.

UTAH STATION.—J. W. Sanborn has tendered his resignation both as president of the college and director of the station, and associated himself with *The Mirror and Farmer* as its agricultural editor.

LOUISIANA SUGAR SCHOOL.—At its first annual commencement, held June 30, 1894, this institution celebrated the completion of the first century of sugar growing in Louisiana, as the first crop was grown in 1794 by Etienne de Boré.

EXPERIMENT STATION RECORD.

VOL. VI. NO. 2.

The statement is made in a recent article that "statistics would probably show that the farmer's house or barn is destroyed by fire much less frequently than his crops are partially or wholly devastated by drought." Losses from this source are by no means confined to the arid or semiarid regions of the Western United States, but aggregate millions of dollars every year in the so-called humid regions of the Eastern and Southern States as a consequence of the long "dry spells" which prevail in so many localities of those regions. A deficiency of rainfall during a comparatively short period at a critical stage of the growth of a crop, as for instance at the time of formation of seed, may result in serious reduction in yield and quality of crop or in total failure.

The most reliable safeguard against such a result is irrigation in some form. There is reason to believe that the systems of irrigation now so extensively and successfully practiced in the arid and semiarid regions may be employed in modified form and on a smaller scale with marked advantage on at least the more valuable farm lands of the humid regions of the United States.

In such regions there is usually little trouble in securing all the water needed for purposes of irrigation. By impounding the small streams and utilizing the springs which occur on almost every farm sufficient water might be stored at small expense to carry the crops safely over the one or two "dry spells" which are likely to occur during the growing season. The construction of extensive reservoirs and canals of course could not wisely be undertaken, but on a great many farms the topographical conditions are such that the small streams might be collected in reservoirs from which the water might be distributed by means of open ditches over a large area of the farm, or a portion of the flow of larger streams might be diverted and distributed by the same means in time of need. In fact this kind of irrigation, especially in meadows, is already practiced to a limited extent in the Eastern United States.

Such a system intelligently practiced would very largely eliminate the element of chance in farming operations and reduce the culture of the soil more nearly to a science. Besides affording greater security it would permit of intensive cultivation and the widest diversification of

crops. The latter is a matter of highest importance in those regions which are at present confined to the production of one or two staple crops, such as cotton, corn, or wheat. Under this one-crop system failure of the crop is a much more serious matter than under a system in which a variety of crops is grown. The ability to diversify crops so as to enable the farmer to more fully supply the needs of home consumption and to cater to the varying demands of the markets must result in increased prosperity in these regions.

Some of the experiment stations are giving considerable attention to studies regarding the amounts of water required by different crops for perfect development, as well as the best time and methods of applying it. It would be well to consider also the economy of water storage and irrigation on a small scale as suggested above. Investigations which would show the cost and practicability of such irrigation relative to the conditions of different localities and the needs of different crops might be productive of important and valuable results.

The act of Congress making appropriations for this Department for the current fiscal year provides for an investigation on "the nutritive value of the various articles and commodities used for human food, with special suggestion of full, wholesome, and edible rations less wasteful and more economical than those in common use." The supervision of this work has been assigned to this Office and Prof. W. O. Atwater has been appointed special agent in charge. It is proposed to make analyses of food materials, as far as this may be necessary; to study the diet aries of different classes of people in different parts of the country; to look into the relations of food supply and consumption; to consider how cooking affects the digestibility and economy of food; and especially to make inquiries with a view to the improvement of methods of investigation. During the past year much preliminary work has been done in collating the results of the investigations thus far made in this country and elsewhere. A bulletin containing a résumé of such inquiries and suggestions for further work is already in press. This will be followed by popular and technical bulletins treating various phases of this great subject. The coöperation of the agricultural colleges and experiment stations in these investigations will be sought so far as seems desirable in view of their facilities for this kind of research and the demands of the work in which they are already engaged. It is expected that other educational and scientific institutions, as well as benevolent associations, may join in the effort to show how our people may have food which is better adapted to their needs and how the expenditures for food, which form so large a percentage of the cost of living, may be more wisely and economically made.

FORAGE PLANTS OF SECONDARY OR UNDETERMINED IMPORTANCE FOR THE SOUTHERN STATES, AND THE COMPOSITION OF FORAGE PLANTS GROWN IN THE SOUTH.

S. M. Tracy.

The Department of Agriculture has frequently called attention to the advantages of the South as a hay-producing region, and as long ago as the year 1854 distributed seeds of several new varieties of grasses to planters in Georgia and Florida. Many distributions were made later, and the results of these efforts were so encouraging that in 1888 Commissioner Colman established a station for special work with forage plants in connection with the Mississippi Experiment Station, and during the following year additional stations were provided for in connection with the State experiment stations of North Carolina, Georgia, Florida, and Louisiana. This arrangement enabled the Department to make systematic tests of the different plants on the most characteristic Southern soils, and to unify the work in such a manner as to make it more economical and effective than was possible by any miscellaneous distributions. This work was assigned to the immediate supervision of the writer, under the general direction of the botanist of the Department.

During the 5 years since the work was inaugurated 508 species have been planted at these stations, and many of them under widely varying conditions. Seeds of many species were obtained through the kindness of Department correspondents in Australia, France, India, Russia, and other foreign countries; others were secured from the arid regions of the Southwest and from Mexico, and special attention was given to the cultivation of such local and native species as seemed to have value for either hay or pasture.

Summer pastures are abundant and good throughout the entire South, but from December to March the native pastures are poor and unreliable. In nearly the whole of this region annual plants like crab grass, Mexican clover, and lespedeza have been the main reliance for hay, and permanent meadows like the timothy and clover fields of the North have been rare. In the older portions of the country the vegetable matter in the soil has become almost exhausted by long cultivation in cotton and other hoed crops, and the natural fertility of the fields can be restored most cheaply by cultivating leguminous plants like red clover and cowpea, by turning under green crops, and by pasturing the fields.

The work undertaken by the Department has been, in its main object, to ascertain the value of different forage plants for permanent and temporary meadows and pastures, and for green manuring.

Farmers' Bulletin No. 18, of the Department, prepared by the writer, gives accounts of the species whose value to the South has been definitely established. The following is a summary of that bulletin:

"With reference to the selection of forage plants adapted to different regions, the soils of the South Atlantic and Gulf States may be classified as follows:

"(1) Yellow loam soils; (2) alluvial and river-bottom soils; (3) black prairie soils; (4) pine woods soils.

"The plants most successfully grown for different purposes on these soils are enumerated below:

"*Forage plants for yellow loam soils.*—For permanent meadows on rich land, Bermuda grass; for a hay crop to occupy rich land 2 years, red clover; for a single hay crop on fair soils, cowpeas; on poor soils, lespedeza. For permanent pastures, Bermuda grass and lespedeza, to which may be added on dry soils orchard grass, Hungarian brome grass, and bur clover; on wet soils the addition should consist of redtop, water grass, and alsike clover. Crimson clover, rescue grass, Terrell grass, and hairy vetch are recommended for winter pasture.

"*Forage plants for the alluvial and river-bottom soils.*—For permanent meadows, Bermuda grass and red clover; on wet spots, redtop; and on all well-drained soils, alfalfa. For a hay crop for a single season, lespedeza, or German millet. For pastures, Bermuda grass, lespedeza, redtop, alsike clover, bur clover, alfalfa, Japanese rye grass, large water grass, and Terrell grass.

"*Forage plants for the black prairie soils.*—For hay, Bermuda grass, red clover, and melilotus. For a hay crop for a single season, lespedeza. For a catch crop, following oats, potatoes, etc., cowpeas or German millet. For pastures, Bermuda grass, lespedeza, melilotus, alsike clover, Hungarian brome grass, orchard grass, redtop, bur clover, and hairy vetch.

"*Forage plants for the pine woods soils.*—For hay, Bermuda grass, crab grass, Mexican clover, alfalfa, crimson clover, and lespedeza. For pastures, crimson clover, Japanese rye grass, orchard grass, carpet grass, and large water grass."

The practical and economic results of the work which the Department has done to encourage the growing of hay and the making of better pastures in the Southern States is clearly shown in the great changes which have been made in the agricultural practices of that region since the beginning of the work. The old idea that the better cultivated grasses can not be successfully grown in the South has been dispelled, and, as a result, the live stock and dairy interests are being developed more rapidly there than in any other section of the country. The demonstration of the fact that green manures are the cheapest and most effective fertilizers is rapidly increasing the acreage of clovers, melilotus, and other leguminous crops, and is causing a corresponding reduction in the amount of money expended for commercial fertilizers. Before the inauguration of this work the larger part of the hay sold in the States south of the Ohio River crossed that stream on its way from the producer to the consumer; but the Department has now demonstrated that in the Southern States good hay can be made at less expense and good pastures can be had during more months in a year than in any other part of the country. The census returns for 1879 show that in the 5 States where this work has since been carried on the yield of hay amounted to only 0.86 ton per acre, against an average of 1.14 tons for the whole United States. The returns made to this Department in November, 1893, show that during

that year the same 5 States had increased their average yield to 1.66 tons per acre, while the average for the entire country was only 1.32 tons. The increase in acreage has fully kept pace with the increased tonnage, and in nearly all of the Southern States the importation of Northern hay has practically ceased.

The work which has been accomplished has demonstrated that a large number of grasses and forage plants can be cultivated profitably for hay or pasture in all the Southern States, and Southern planters are now taking advantage of the facts thus gained to broaden their meadows, improve their pastures, and fertilize their fields.

The forage plants of which the success is assured having been treated fully in Farmers' Bulletin No. 18, it remains to consider in this article those of which the value is not yet established, or whose merits do not place them among the most important forage plants for the South. The plants which, according to the experiments referred to above, are classed as of secondary importance are the following:

Grasses.—Cane (*Arundinaria tecta*), Indian beard (*Chrysopogon serrulatus*), everlasting (*Eriochloa annulata*), Mexican everlasting (*E. aristata*), Para (*Panicum barbinode*), showy panic (*P. sanguinale*), Anjan (*Pennisetum cenchroides*), and Texas blue grass (*Poa arachnifera*).

Leguminous plants.—Beggar weed (*Desmodium molle*), flat pea (*Lathyrus sylvestris*), and soja bean (*Soja hispida*).

Cane (*Arundinaria tecta*).—Cane is one of the common wild grasses of the whole country south of the Ohio River, except in the sandy lands of the pine woods. It has a woody, perennial stem which grows from a few inches to 20 or 30 ft. in height, and, as its leaves are evergreen, they furnish a valuable supplement to the winter pastures, and thousands of animals have almost no other winter food. The cane is seldom found except along creek banks and on swampy ground, and its growth is usually so scattering and so much exertion is needed to secure a sufficient supply that it can do little more than sustain life, and is of no value for fattening or milch animals. None of the many attempts at its cultivation have been successful.

Indian beard grass (*Chrysopogon serrulatus*).—This is a perennial grass, the seed of which was imported from India in 1889, and which promises to be a valuable species for dry uplands. Although nearly related to the native broom sedge, it starts into growth much earlier in the spring, produces a heavier growth of leaves, and will yield two cuttings of fair hay, besides a considerable amount of late pasturage. It has been entirely free from attacks of blight and other fungus diseases, and is spreading well by self-sown seed. It grows from 4 to 5 ft. high, branching widely, and more than half the weight of the hay is made up of the leaves, the stems being quite slender. This seems to be the most valuable of the many sorts received from India, but as the amount of seed sent us was very small it has not yet been planted on a scale sufficiently large to justify its recommendation for general cultivation.

Everlasting grass (*Eriochloa annulata*).—The Department imported seed of this from Australia in 1889 and, while it promises to be valuable for the Gulf coast, it has not succeeded as well in the northern districts as in its native country. In Australia it is a perennial, but here it barely survives the winter, and a large part of its spring growth comes from seeds which were scattered on the ground during the previous season. It starts its new growth early in the spring, reaching a height of about 2 ft., and producing a large number of slender culms, which are well covered with leaves and an abundant supply of seed. It bears pasturing well and late in the season makes excellent hay. Mr. Turner, the botanist of the Australian Department of Agriculture, says that this is "a superior pasture grass, found in the coastal districts, and in the colder parts of the colony. It will grow and furnish feed nearly all the year round in the coastal districts, but during the early summer months it yields a great amount of rich, succulent herbage, greedily devoured by stock of all kinds. This grass is worthy the attention of dairy farmers." In this country we find its chief value to be for mixing with other grasses for pasture late in the season, and this only in the southern districts.

Mexican everlasting grass (*Eriochloa aristata*).—Seed of this was procured from Mexico in 1888, and it is much more promising than the Australian species. It produces a heavier growth, is more hardy, and is less injured by droughts. It is an annual, but reseeds the ground so freely that it may be treated as a perennial. It grows fully 3 ft. in height and will make two good crops of hay annually, its best growth being from the second crop, which is ready to cut in October and which makes rich, tender, and nutritious hay. As it has a larger proportion of leaves and seeds than crab grass, and may be grown in the same inexpensive manner, we value it highly.

Para grass (*Panicum barbinode*).—This is a perennial species which produces runners from 10 to 20 ft. in length, with an abundant supply of leaves and upright branches, yielding an immense amount of forage. It does not mature seed in this latitude, but the roots live through the winter, the new growth being ready to cut by June 1, and yielding a good cutting once in 6 weeks until the end of the season, though it should not be cut after October 1, in order that it may have time to produce a crop of leaves to serve as a winter protection to the roots. It is of considerable value for the region near the coast, but is too tender to be recommended for localities subject to severe frosts. The "showy panic" (*Panicum spectabile*) from southern Europe is very similar to Para grass, but is rather coarser and does not appear to be so well relished by stock, though it bears a lower temperature.

Anjan grass (*Pennisetum cenchroides*).—This is common on the plains of northwestern India, especially in the sandy districts, where it is regarded as an excellent fodder grass for both horses and cattle, and where it yields three annual cuttings for hay. It is so highly recommended for pastures in its native country that the Department went to

considerable trouble and expense to secure a supply of the seed in 1889, and it has been carefully tested at each of the stations, but with disappointing results. It does not begin its growth until late in the spring, and, as it is killed by even moderate frosts, it fails to give either late fall or early spring pastures, and its growth is too small for a profitable hay crop. As it will make a fair growth on sandy soils which are too loose for most other grasses, it is of some value along the coast region, but will not pay for planting elsewhere.

Texas blue grass (*Poa arachnifera*).—This was extensively distributed by the Department about 10 years ago, and is now widely advertised by many dealers throughout the South, but its real value for cultivation is still unsettled. It is a perennial, and emphatically a winter-growing species. In favorable locations it begins its growth in October, and from December to May furnishes an abundance of luxurious pasturage. It matures its seed in April, and by June the leaves become dry and withered and little is seen of it until October. Its growth depends so much on slight differences in soil that it is impossible to locate any sections where the planter may be absolutely sure that it will succeed. On the red and gravelly soil of the North Carolina Station it has done but little, making only a moderate growth the first season and soon disappearing. At the Georgia Station, on a soil apparently similar to that in North Carolina, it has done better, though not as well as the Kentucky blue grass; in several other places in the same State it has proved very satisfactory. R. J. Redding, the director of the Georgia Station, states that on a pebbly, sandy loam underlaid by heavy clay, in the pine woods region of western Georgia, it holds its own well against broom sedge, briers, and other noxious weeds, and grows well in the shade of trees, even at the roots of the large pines. He regards it as being well adapted to both lawns and pastures in the pine woods region of the south Atlantic and Gulf States. At the Florida Station it has succeeded admirably on a loose, white, sandy soil, making a heavy sod and entirely checking the growth of other grasses and weeds. Both there and at the Louisiana Station it is regarded as a very desirable winter grass. At the Mississippi Station it was planted in a dozen or more places, and with varying results. On light, rich soil it made a vigorous growth which fully covered the ground within 6 months from planting, and furnished good winter grazing during 4 years. Planted on equally good and well prepared ground which was already set in Bermuda it lived, but increased very little, and now only occasional plants are to be seen. On dry, heavy clay it nearly all died during the first season, while on some of the black prairie lands it did well. A rich, loamy soil seems best adapted to its growth, but in many places where the soil has appeared to be suitable the growth has been disappointing. It is difficult to propagate from the seed, but can be increased rapidly by means of the underground stolons, which are produced in great abundance,

and which should be planted in August or September, about 2 ft. apart in each direction.

Beggar weed (*Desmodium molle*).—Seed of this plant was first distributed by the Department in 1879, and it has proved to be of considerable value for summer grazing, especially on the light sandy soils of Florida, but is too coarse and woody for making hay. It is an annual which is closely related to the common "beggar-ticks" but is much larger, often reaching 8 or 10 ft. in height, has a larger proportion of leaves, and the seeds are so nearly smooth that they do not stick to clothing as do the seeds of the native sorts. When used for hay it should be cut when not more than 2 or 3 ft. high as, if allowed to grow larger, the lower leaves drop and the stems become coarse. J. C. Neal, formerly of the Florida Station, says it is especially valuable in Florida, enriching the soil beyond any other crop, and that nothing is better to restore health and vigor to a worn-out beast than a few weeks in a beggar-weed pasture. R. J. Redding, of the Georgia Station, speaks well of it for southern Georgia, but says it is not grown in the northern part of that State. J. S. Newman, formerly of the Alabama Station, condemns it for that State; while W. C. Stubbs, of the Louisiana Station, says that "when sown thickly and cut early it produces a large amount of fairly good hay." In Mississippi it has grown well and reseeded the ground on sandy soils, but has not been satisfactory when planted on heavy clay lands. It is valued most as a renovating crop for lands on which clover can not be grown.

Flat pea (*Lathyrus sylvestris*).—Extravagant claims have been made for this by the dealers who introduced it, and who stated that the plants would grow luxuriantly and give immense annual crops on the driest and most barren soils, "lasting over 50 years and giving £20 profit each year." The Department procured a supply of the seed in 1889, and the plant has been thoroughly tested at each of the Southern stations, and with uniformly disappointing results. The seeds germinate slowly, and if not cultivated carefully the young plants will soon be choked out by the grass and weeds. Few of the plants reach more than 6 in. in height during the first season, but after that they become stronger and at 4 years old give fair crops of excellent hay and afford good fall and spring grazing. Its growth is low and straggling, but the stems are quite slender and are well covered with leaves, and the whole plant is relished well by cattle and horses. The plants remain almost dormant through the summer and are killed to the ground by moderate frosts, and so yield nothing for pastures during the summer or late winter. We have seen nothing to recommend it for cultivation in the South.

Soja bean (*Soja hispida*).—This has varied greatly with the soils upon which it has been grown, and has not been generally satisfactory. It is an upright annual, reaching about 3 ft. in height on good soil, and, under favorable conditions, producing an immense yield of seed. When well grown, its stems are too coarse and heavy

for hay, though when used for soiling while fresh, they are sufficiently tender to be eaten well. Its abundance of leaves and unusually large proportion of seeds make it one of the richest foods we have grown, and were it not for the large stalks we should value it highly; but the hay is difficult to cure, the seeds and leaves drop badly in handling, and few animals will eat the bare, coarse stems. It has made its best growth on rich river-bottom soils, and has not been satisfactory when planted on thin or light soils. It fruits less abundantly in the extreme South than further north, and we have found no locality where it equals the cowpea for hay. Seed should be sown in drills 3 ft. apart, at the rate of a half bushel per acre, and at any time from May to July. If sown broadcast, double the amount of seed should be used.

Promising grasses.—Among the hundreds of species which have been tested since the inauguration of this work there are many which are very promising, but which have not yet been grown a sufficient length of time or on sufficient areas to determine their real values or the uses to which each is best adapted, though from present indications a number of these recent introductions will find a permanent place among our forage plants. Bush lespedeza (*Lespedeza cyrtobotrya*), from Japan, is a shrubby plant which grows from 6 to 10 ft. in height, and is valuable for woods pastures, though not suitable for hay or for land which is to be plowed. Red panic (*Panicum roseum*), from Australia, grows vigorously, bears drought well, and makes good late pasture on dry soils. Teff (*Eragrostis abyssinica*), which is grown very extensively in India, makes a heavy yield of fine hay when grown from imported seeds, but seed grown in this country has so far germinated poorly. Colorado turkey-foot (*Andropogon hallii*) is one of the few Western species which has done well on soils too dry and hard to support redtop, and promises well for pasture lands. Large bunch grass (*Sporobolus airoides*), tall mesquit (*Bouteloua racemosa*), purple water grass (*Paspalum purpurascens*), and Mexican panic (*Panicum palmeri*), are other species which have given good results in a few localities.

Undesirable species.—Many species which have succeeded well in more northern States and which are often recommended for general cultivation have been planted, but with unsatisfactory results. Among these have been tall oat grass (*Arrhenatherum elatius*), which makes only a moderate growth, disappearing at the end of the second season; velvet grass (*Holcus lanatus*), which is usually very scattering in its growth and is not relished by stock; meadow fescue (*Festuca pratensis*), which does fairly well the first season, but has never made even a half crop the second season; crested dog-tail (*Cynosurus cristatus*), meadow foxtail (*Alopecurus pratensis*), rough-stalked meadow grass (*Poa trivialis*), and wood meadow grass (*Poa nemoralis*), all of which die on the first approach of hot weather; and many of the sheep fescues (*Festuca ovina*), which yield only a small amount of grazing early in the spring.

Of the scores of foreign grasses which have been tested and proved worthless no mention need be made, and there are many others which,

although promising well for certain localities, have not yet been grown for a sufficient length of time to determine their true value for general cultivation.

ANALYSES OF SOUTHERN-GROWN FORAGE PLANTS.

In connection with the work done in the fields, chemical analyses have been made of freshly gathered samples of all the more important species, and of many species several analyses have been made from samples gathered at different periods of growth. All of the analyses reported here have been made from samples taken on the grounds of the Mississippi Station, and nearly all of the work has been done by L. G. Patterson, the chemist of that station.

In order to facilitate comparisons of these with the same species when grown in Northern States he has compiled the averages of the Northern-grown samples, as reported by Jenkins and Winton in Bulletin 11, Office of Experiment Stations, and included them in the table at the end of this article.

A comparison of the Northern and Southern grown hays shows very clearly the larger proportions of protein and fats (ether extract) contained in many of the latter, and their consequent superiority for feeding purposes. It is a well-known fact that as hay plants become older the proportion of crude fiber is increased at the expense of the more valuable protein and carbohydrates. As a rule the Northern meadows are mowed but once during a season, while those of the South are usually mowed two or three times, so that the season of growth for each crop of the Southern hays is really shorter than for those of the North, a condition which renders superior the quality of the former. A comparison of the composition of 9 leguminous plants grown North and South was made. The following table contains a list of the 8 leguminous plants that afforded a larger percentage of protein when grown in the South than when grown farther North:

Protein in Southern and Northern grown leguminous plants.

		Number of analyses.	Protein in dry matter.	Difference.
			Per cent.	*Per cent.*
Cowpea (*Dolichos sinensis*)	Southern	2	23.64	8.54
	Northern	9	15.10	
Alfalfa (*Medicago sativa*)	Southern	8	19.90	2.80
	Northern	23	17.10	
Bokhara clover (*Melilotus alba*)	Southern	8	21.93	8.73
	Northern	6	13.20	
Soja bean (*Soja hispida*)	Southern	3	20.99	8.99
	Northern	6	12.00	
Red clover (*Trifolium pratense*)	Southern	7	19.04	4.74
	Northern	43	15.30	
White clover (*T. repens*)	Southern	4	21.28	0.98
	Northern	1	20.30	
Hairy vetch (*Vicia villosa*)	Southern	3	23.90	7.10
	Northern	4	16.80	
Alsike clover (*Trifolium hybridum*)	Southern	1	17.38	2.08
	Northern	4	15.30	

The only leguminous plant in which analysis showed a higher protein content of Northern than of Southern grown was the common vetch (*Vicia sativa*). In 3 analyses of Northern-grown plants *Vicia sativa*

averaged 30.7 per cent of protein in the dry matter. In 4 analyses of Southern-grown plants the protein content was only 21.95 per cent. However, in this case the dates at which the samples were taken suggest that the Northern plants were the younger when analyzed, and this fact would explain the exception to the apparent rule that Southern-grown leguminous plants contain in their dry matter a larger proportion of protein than Northern-grown legumes. Northern-grown plants of the common vetch were taken for analysis April 23, May 4, and May 21; Southern grown, June 1 in three instances and July 1 in one instance. That the Northern-grown vetch plants were sampled at earlier stages of growth than were the Southern-grown plants is confirmed by the fact that the former averaged only 15.8 per cent of fiber in the dry matter, while the Southern-grown plants contained 28.23 per cent of fiber.

The average of 2 Northern analyses of spurry showed more than twice as much protein as was contained in 1 Southern-grown sample. However, the former averaged only 18.25 per cent of fiber in the dry matter while the latter contained 24.38 per cent of fiber, suggesting that the apparent advantage of Northern-grown spurry was at least partly attributable to its having been harvested at an earlier stage of maturity than the plants analyzed at the Mississippi Station. That 4.56 per cent of protein is quite low for Southern-grown spurry appears probable when the analysis made at the Mississippi Station is compared with one made at the Alabama College Station (Bulletin 49) in which protein constituted 11.56 per cent of the dry matter of the plant. In this latter case the crude fiber, 18.95 per cent, and probably the stage of development of the plant, agreed closely with the figures for Northern-grown spurry. In this connection mention of an analysis of spurry plant with mature seed made at the Michigan Station (Bulletin 101) should not be omitted. The dry matter of the plant contained 14.32 per cent of protein accompanied by 60.35 per cent of fiber.

Of 19 grasses, the composition of which when grown North and when grown South was compared, Southern plants gave a higher protein content in the case of 7 species and a lower protein content in the case of 12 species. Following is a list of the 7 grasses affording a higher protein content when grown in the South:

Protein in Southern and Northern grown grasses.

		Number of analyses.	Protein in dry matter.	Difference.
			Per cent.	*Per cent.*
Tall oat grass (*Arrhenatherum elatius*)	Southern	3	12.35	3.65
	Northern	6	8.70	
Rescue grass (*Bromus unioloides*)	Southern	5	17.08	4.18
	Northern	5	12.90	
Orchard grass (*Dactylis glomerata*)	Southern	5	13.87	5.17
	Northern	....	8.70	
Meadow fescue (*Festuca pratensis*)	Southern	2	9.27	1.27
	Northern	4	8.00	
Italian rye grass (*Lolium italicum*)	Southern	2	18.30	6.90
	Northern	33	11.40	
Kentucky blue grass (*Poa pratensis*)	Southern	4	13.07	2.57
	Northern	16	10.50	
Johnson grass (*Sorghum halepense*)	Southern	8	10.72	4.02
	Northern	2	6.70	

The following list contains the names of grasses which were richer in protein when grown in the North:

Protein in Southern and Northern grown grasses.

		Number of analyses.	Protein in dry matter.	Difference.
			Per cent.	*Per cent.*
Redtop (*Agrostis vulgaris*)	Northern	5	9.40	2.94
	Southern	3	6.46	
Broom grass (*Andropogon scoparius*)	Northern	1	4.10	0.29
	Southern	2	3.81	
Blue stem (*A. provincialis*)	Northern	1	8.20	1.33
	Southern	2	6.87	
Sweet vernal grass (*Anthoxanthum odoratum*)	Northern	7	9.60	4.48
	Southern	1	5.12	
Erect brome grass (*Bromus erectus*)	Northern	4	11.19	3.72
	Southern	1	8.18	
Cheat (*B. secalinus*)	Northern	1	8.00	2.82
	Southern	1	5.18	
Sheep fescue (*Festuca ovina*)	Northern	7	10.30	3.22
	Southern	2	7.08	
Munro grass (*Panicum agrostoides*)	Northern	1	6.90	1.79
	Southern	1	5.21	
Tall panic (*P. virgatum*)	Northern	1	10.50	6.69
	Southern	1	3.81	
Timothy (*Phleum pratense*)	Northern	56	8.00	1.49
	Southern	1	6.51	
Wood meadow grass (*Poa nemoralis*)	Northern	2	8.70	0.10
	Southern	1	8.60	
Foxtail (*Setaria glauca*)	Northern	2	13.00	3.80
	Southern	1	9.20	

In the first list of grasses the figures in every case represent the average of 2 or more analyses. In the latter list, if we eliminate all grasses of which only 1 analysis either of Southern or of Northern grown plants is recorded, we have left only 2 grasses, viz, redtop and sheep fescue. Hence, of the grasses here compared, of which the average composition may be regarded as in some degree fixed, we find that 6 are richer when Southern grown and only 2 are richer when Northern grown. Since the plants grown North and South were not sown and cut for analysis at corresponding dates, and since the difference in protein content of the dry matter may be due to differences in the maturity of the plants, it may be of interest to consider the relative proportion of fiber in the plants, assuming that a large amount of fiber is indicative of an advanced stage of maturity, and that this stage is normally accompanied by a low protein content. Of the 12 grasses having their maximum protein content when grown in the North all except cheat grass and wood meadow grass (both of which were analyzed only once) have their minimum fiber content when grown there, and hence presumably they were cut at an earlier stage of growth than the same plants when grown in the South. In the case of the 6 grasses showing superiority in protein in the South the fiber content was in five cases practically identical in Northern and Southern grown samples, thus suggesting similarity in the stage of development of the two sets of samples. This superiority of Southern-grown grasses in protein, unaccompanied by a decrease in fiber, suggests that the variation in the composition of grasses grown in different latitudes may not be entirely dependent on difference in the maturity of the plants.

The following table gives the composition of plants grown and analyzed at the Mississippi Agricultural Experiment Station, and in some cases for comparison the composition of Northern-grown plants as compiled by Jenkins and Winton:

Composition of forage plants.

	Number of analyses.	Water.	In dry matter.				
			Crude fiber.	Crude protein.	Ether extract.	Nitrogen-free extract.	Ash.
GRASSES.		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Japanese rye (*Agropyrum japonicum*)	5	64.41	27.43	11.10	3.17	51.87	6.43
Hair grass (*Agrostis scabra*)	1	59.37	34.93	9.70	2.35	47.87	5.15
Red top (*A. vulgaris*)	3	57.77	32.46	6.46	2.43	51.24	7.41
Northern grown	....	64.80	26.80	9.40	3.30	53.90	6.60
Australian blue grass (*Andropogon annulatus*)	2	64.94	35.91	7.97	3.58	46.20	6.34
Broom grass (*A. scoparius*)	2	....	41.99	3.81	0.93	48.67	4.60
Northern grown	1	57.08	37.80	4.10	1.40	52.70	4.00
Blue stem (*A. provincialis*)	2	55.57	43.12	6.87	2.48	41.10	6.43
Northern grown	....	....	31.50	8.20	2.30	52.10	5.90
Broom sedge (*A. virginicus*)	1	48.15	42.11	2.64	3.51	46.52	5.22
Sweet vernal grass (*Anthoxanthum odoratum*)	1	49.80	49.49	5.12	2.44	35.98	6.97
Northern grown	7	70.97	25.50	9.60	3.90	54.80	6.20
Poverty grass (*Aristida depressa*)	1	52.79	40.27	10.37	1.23	38.57	9.56
Tall oat grass (*Arrhenatherum elatius*)	3	67.08	30.13	12.35	3.75	44.56	9.21
Northern grown	....	....	30.90	8.70	3.20	50.70	6.50
Oats (*Avena sativa*)	1	80.73	26.12	14.63	2.91	46.23	10.11
Hungarian brome (*Bromus inermis*)	2	....	32.11	11.86	4.91	39.50	8.62
Soft chess (*B. mollis*)	1	....	34.02	10.05	4.08	45.13	6.72
Erect brome grass (*B. erectus*)	1	62.32	32.04	8.18	2.67	44.79	12.32
Northern grown	4	71.90	25.30	11.90	3.40	51.70	7.70
Cheat (*B. secalinus*)	1	58.54	29.30	5.18	2.59	57.32	5.61
Northern grown	1	60.35	32.90	8.00	2.80	51.60	4.70
Rescue grass (*B. unioloides*)	5	77.68	26.03	17.08	4.09	40.47	12.33
Northern grown	5	73.53	21.70	12.90	3.40	53.10	8.90
Bur grass (*Cenchrus catharticus*)	1	72.25	34.28	11.21	1.94	47.97	4.60
Bur grass (*C. montanus*)	1	75.14	35.84	7.21	2.48	45.97	8.50
Star grass (*Chloris barbata*)	2	66.58	35.04	11.59	2.37	43.74	7.26
Star grass (*C. acicularis*)	1	74.23	35.16	9.40	2.64	45.29	7.51
Indian beard grass (*Chrysopogon serrulatus*)	1	67.29	39.40	5.85	2.95	45.64	6.16
Orchard grass (*Dactylis glomerata*)	5	....	29.91	13.87	3.47	42.30	10.45
Northern grown	....	....	30.93	8.70	3.20	49.40	6.50
Eaton grass (*Eatonia pennsylvanica*)	1	69.03	35.73	7.84	2.75	46.84	6.84
Indian millet (*Eleusine corocana*)	2	75.23	26.63	13.19	2.49	49.32	8.37
Indian crowfoot (*E. flagellifera*)	1	73.22	32.77	10.58	1.92	47.38	7.35
Crowfoot (*E. indica*)	3	70.04	31.66	10.91	2.45	43.33	11.65
Indian crowfoot (*E. scindica*)	1	68.00	30.59	6.36	2.77	51.25	9.03
Terrell grass (*Elymus virginicus*)	3	53.89	29.96	7.89	2.80	52.29	7.06
Teff (*Eragrostis abyssinica*)	1	56.37	35.33	9.89	2.03	46.49	6.26
Slender meadow grass (*E. pilosa*)	3	....	32.14	11.71	2.16	45.80	8.19
Everlasting grass (*Eriochloa annulata*)	2	65.38	32.01	9.33	3.43	46.55	8.68
Mexican everlasting grass (*E. aristata*)	1	82.96	31.85	17.08	3.26	38.30	9.51
Everlasting grass (*E. punctata*)	2	....	34.00	11.23	2.71	43.52	8.54
Hard fescue (*Festuca duriuscula*)	2	....	38.17	7.44	2.99	45.36	6.08
Fall fescue (*F. elatior*)	1	72.07	37.62	6.14	3.06	44.67	8.51
Sheep fescue (*F. ovina*)	2	....	37.69	7.08	3.57	44.98	6.68
Northern grown	7	64.12	25.50	10.30	3.10	55.00	6.10
Meadow fescue (*F. pratensis*)	2	....	33.48	9.27	4.15	45.01	5.09
Northern grown	4	69.85	35.70	8.00	2.80	47.50	6.00
Slender fescue (*F. tenuifolia*)	1	....	33.99	14.98	4.19	39.43	7.41
Red fescue (*F. rubra*)	2	....	33.51	5.95	3.64	49.76	7.14
Slender fescue (*F. tenella*)	1	54.66	33.92	8.64	3.15	48.12	6.18
Bermuda grass (*Cynodon dactylon*)	6	....	28.39	12.52	3.29	46.45	9.35
Fowl meadow grass (*Glyceria nervata*)	1	....	29.44	9.48	2.48	48.32	10.28
Northern grown	....	....	33.50	10.40	2.00	46.40	7.30
Velvet grass (*Holcus lanatus*)	1	....	33.94	7.19	3.18	47.12	8.57
Northern grown	....	....	21.80	9.90	4.20	55.00	9.10
Cut grass (*Leersia virginica*)	1	....	31.57	7.24	2.15	49.01	10.03
Feather grass (*Leptochloa mucronata*)	2	72.69	29.92	17.28	2.50	38.77	11.53
Italian rye grass (*Lolium italicum*)	2	80.72	27.17	18.30	4.04	39.06	11.43
Northern grown	33	73.16	25.10	11.40	5.00	49.30	9.20
English rye grass (*L. perenne*)	1	....	29.13	8.57	7.55	26.69	8.06
Northern grass	5	74.9	21.30	10.50	3.60	56.20	8.40
Slender rye grass (*L. tenue*)	1	....	32.28	7.35	3.93	49.86	6.58
Nimble Will (*Muhlenbergia diffusa*)	1	....	34.45	7.21	2.68	48.22	7.44

Composition of forage plants—Continued.

	Number of analyses.	Water.	In dry matter. Crude fiber.	Crude protein.	Ether extract.	Nitrogen-free extract.	Ash.
GRASSES—continued.		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Many-flowered millet (*Milium multiflorum*)	1	....	31.95	9.49	3.59	49.22	5.75
Munro grass (*Panicum agrostoides*)	1	51.25	36.32	5.21	1.76	50.73	5.98
Northern grown	1	65.01	29.80	6.90	1.80	51.40	10.10
Two-edged panic (*P. anceps*)	2	....	36.27	10.46	1.20	44.27	7.80
Tall panic (*P. autumnale*)	1	....	33.73	14.35	2.38	45.69	3.85
Old witch grass (*P. capillare*)	2	....	38.21	13.29	2.12	38.26	8.12
Indian panic (*P. cinicinum*)	1	70.24	29.85	6.14	2.58	48.89	12.54
Panic (*P. commutatum*)	1	74.87	34.40	10.34	1.96	44.19	9.11
Panic (*P. consanguineum*)	1	71.40	31.16	11.70	1.93	47.26	7.95
Mutton cane (*P. dichotomum*)	2	....	35.56	9.22	2.10	44.05	9.07
Slender crab grass (*P. filiforme*)	1	....	34.39	8.56	1.83	48.25	6.97
Indian millet (*P. frumentaceum*)	2	57.11	32.50	10.10	1.58	44.86	10.96
Panic grass (*P. gibbum*)	1	67.92	24.96	8.44	5.02	52.79	8.79
Panic (*P. neuranthemum*)	1	56.05	33.98	8.31	2.46	42.57	12.68
Panic grass (*P. proliferum*)	3	76.86	31.23	10.98	2.52	46.19	9.08
Crab grass (*P. sanguinale*)	4	....	31.05	8.26	3.32	47.69	9.68
Texas millet (*P. texanum*)	2	72.79	30.42	6.54	3.99	47.87	11.18
Fall panic (*P. virgatum*)	1	55.56	39.52	3.81	1.97	50.51	4.19
Northern grown	1	65.16	29.80	10.50	2.40	51.70	5.60
Large water grass (*Paspalum dilitatum*)	3	74.61	33.68	6.73	2.98	48.74	7.87
Florida water grass (*P. floridanum*)	1	72.55	32.53	6.84	1.05	54.93	4.65
Water grass (*P. paniculatum*)	1	....	31.73	9.87	3.35	45.51	9.54
Carpet grass (*P. platycaule*)	1	....	32.14	5.65	2.77	49.63	9.81
Blue canary grass (*Phalaris cœrulescens*)	1	66.11	33.05	10.19	3.87	45.75	7.14
Canary grass (*P. canariensis*)	1	58.06	37.65	6.08	2.43	48.27	5.57
Timothy (*Phleum pratense*)	1	60.38	34.17	6.51	2.85	48.84	7.63
Northern grown	55	61.58	30.70	8.00	3.10	52.80	5.40
Low spear grass (*Poa annua*)	1	77.86	20.46	25.98	3.58	31.08	18.90
Texas blue grass (*P. arachnifera*)	4	....	32.10	11.03	4.00	45.62	7.25
Southern spear grass (*P. flexuosa*)	1	62.60	33.93	6.18	2.64	49.17	8.08
Wood meadow grass (*P. nemoralis*)	1	....	33.80	8.60	3.80	47.95	5.85
Northern grown	2	65.45	34.30	8.70	2.70	49.10	5.20
Kentucky blue grass (*P. pratensis*)	4	....	30.05	13.07	4.38	42.02	8.48
Northern grown	....	....	26.10	10.50	3.60	51.90	7.90
Fox tail (*Setaria glauca*)	1	86.50	35.04	9.20	2.71	36.31	16.74
Northern grown	2	71.30	23.70	13.00	2.50	51.70	9.10
Purple top (*Sieglingia flava*)	1	....	40.14	6.75	1.64	40.59	10.88
Johnson grass (*Sorghum halepense*)	8	....	32.26	10.72	3.44	45.05	8.53
Northern grown	2	65.31	34.70	6.70	2.50	51.70	4.40
Egyptian rice corn (*S. vulgare*)	1	53.33	28.32	7.29	2.19	53.45	8.75
Kaffir corn (*S. vulgare*)	1	62.50	29.79	7.59	2.03	47.56	13.03
Chicken corn (*S. vulgare*)	2	....	35.10	7.80	1.75	43.78	8.57
Sorghum (*S. vulgare*)	8	52.94	30.18	5.19	2.18	56.72	5.73
Yellow millo maize (*S. vulgare*)	1	59.10	27.29	6.48	3.19	55.58	7.46
White millo maize (*S. vulgare*)	1	70.08	35.06	7.86	2.42	44.66	10.00
LEGUMINOUS PLANTS.							
Beggar weed (*Desmodium molle*)	2	65.21	19.88	23.21	5.48	41.60	9.83
Cowpea (*Dolichos sinensis*)	2	84.57	20.75	23.64	6.97	38.09	10.55
Northern grown	6	82.22	26.00	15.10	2.90	45.20	10.80
Horse bean (*Faba equina*)	1	85.57	27.83	15.17	3.11	42.03	11.86
Vetch (*Lathyrus hirsutus*)	2	....	24.84	21.56	4.36	42.15	7.09
Vetch (*L. pusillus*)	1	....	25.60	24.14	4.63	36.89	8.74
Vetch (*L. sativus*)	3	78.83	26.04	23.76	3.78	37.91	8.51
Flat-pea (*L. sylvestris*)	1	71.17	29.79	24.37	5.58	33.21	7.05
Japan bush clover (*Lespedeza cyrtobotrya*)	2	67.19	32.62	16.15	4.40	40.61	6.22
Japan clover (*L. striata*)	4	....	31.14	13.09	3.60	44.96	7.22
Lupine (*Lupinus perennis*)	1	84.70	31.55	7.40	1.06	48.55	11.44
Bur clover (*Medicago lupulina*)	1	....	21.73	23.94	10.23	32.39	11.71
Bur clover (*M. maculata*)	2	88.22	18.49	23.76	4.26	41.30	12.19
Medick (*M. media*)	1	....	35.15	14.86	3.43	39.18	7.38
Alfalfa (*M. sativa*)	8	....	27.98	19.90	3.50	37.71	10.91
Northern grown	23	71.75	26.20	17.10	3.40	43.90	9.40
Snail clover (*M. turbinata*)	1	63.53	36.40	10.58	2.73	41.89	8.40
Bokhara clover (*Melilotus alba*)	8	....	23.51	21.93	4.05	41.56	8.95
Northern grown	....	....	30.30	13.20	3.80	45.20	7.50
Blue melilot (*M. cœruleus*)	2	77.15	28.35	13.55	2.06	42.42	13.62
Gray winter pea (*Pisum sativum*)	1	70.61	34.03	12.62	3.40	40.26	9.69
Soja bean (*Soja hispida*)	3	69.15	22.28	20.99	4.74	41.28	10.71
Northern grown	5	74.85	29.00	12.00	3.80	45.70	9.50
Alsike clover (*Trifolium hybridum*)	1	75.36	25.30	17.38	2.96	44.84	9.52
Northern grown	....	....	29.20	15.30	3.70	44.00	7.80
Red clover (*T. pratense*)	7	....	24.27	19.04	5.04	41.93	9.72
Northern grown	....	....	27.80	15.30	3.90	45.80	7.20

Composition of forage plants—Continued.

	Number of analyses.	Water.	In dry matter.				
			Crude fiber.	Crude protein.	Ether extract.	Nitrogen-free extract.	Ash.
LEGUMINOUS PLANTS—continued.		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Creeping clover (*T. procumbens*)	1	54.22	36.92	10.16	2.67	35.73	8.52
Buffalo clover (*T. reflexum*)	1	....	27.37	14.34	1.53	49.32	7.44
White clover (*T. repens*)	4	....	21.09	21.28	5.17	40.77	11.69
Northern grown	1	78.23	21.60	20.30	6.50	43.40	8.20
Louisiana vetch (*Vicia ludoviciana*)	1	86.59	12.77	38.70	4.38	33.76	10.39
Vetch (*V. sativa*)	4	68.56	28.23	21.95	3.29	34.98	11.55
Northern grown	3	79.07	15.80	30.70	4.20	37.00	12.30
Hairy vetch (*V. villosa*)	3	78.20	28.39	23.90	4.12	34.28	9.31
Northern grown	4	74.45	27.70	16.80	2.60	42.80	10.10
Chinese vetch (*Vigna* sp.)	1	81.79	31.63	19.56	3.14	35.05	10.62
MISCELLANEOUS.							
Mexican clover (*Richardsonia scabra*)	3	86.77	25.97	10.36	4.43	41.81	17.43
Giant spurry (*Spergula maxima*)	1	75.62	24.21	4.56	3.95	52.65	14.63
Northern grown	2	67.19	18.20	9.60	4.30	53.60	14.30
Corn silage	1	83.31	27.98	7.13	2.82	54.22	7.85
Chicken corn silage	1	75.02	35.07	9.81	2.69	44.85	7.58
Sorghum silage	1	83.81	33.97	6.42	1.73	49.29	8.59
Teosinte silage	1	66.77	37.12	7.64	2.38	40.92	11.94

RECENT WORK IN AGRICULTURAL SCIENCE.

CHEMISTRY.

The determination of phosphoric acid, S. W. JOHNSON (*Jour. Amer. Chem. Soc., 16 (1894), No. 7, pp. 462–465*).—Tests by the author, Wells, and Osborne of the citrate method as compared with the molybdic method, already reported in full in the Report of the Connecticut State Station for 1889 (E. S. R., 2, p. 489), are briefly reviewed. The author concludes that—

"The citrate method only gives good results by compensation of its errors and under exactly defined conditions, which must be empirically determined. A procedure good for calcium phosphates is quite inapplicable to ferric and aluminum phosphates.

"Again, the molybdic method, when carried out rapidly at temperatures higher than 50°, or as high as 65° C., in presence of trivalent iron, aluminum, or manganese, gives results too high, and in presence of great excess of nitric acid may give results too low, unless the filtrates from the yellow precipitate are mixed with additional molybdic solution and further digested until no more precipitate can be thrown down."

On the determination of phosphoric acid as magnesium pyrophosphate, H. NEUBAUER (*Jour. Amer. Chem. Soc., 16 (1894), No. 5, pp. 289–297*.—This is a translation and condensation by K. P. McElroy of an article read before the World's Chemical Congress at Chicago, which discusses in detail investigations already briefly noticed (E. S. R., 4, p. 584).

Systematic determinations were made of the errors due to volatilization of phosphoric acid involved in Wagner's modification of the molybdic method, and a table giving corrections to be used in phosphoric-acid determinations was calculated from the results.

The method of procedure recommended is as follows:

"Separate the phosphoric acid in the form of the yellow precipitate, and wash this latter in the usual way. Too high a heat should not be employed, nor should the solution be allowed to stand too long, lest excess of molybdic acid separate. Dissolve the phosphomolybdate in 100 cc. of cold 2.5 per cent ammonia and add as many cc. of the usual magnesia mixture (55 gm. magnesium chlorid and 70 gm. ammonium chlorid dissolved in a liter of 2.5 per cent ammonia) as there are centigrams of phosphoric acid present. Addition should not be made faster than 10 cc. per minute. Stir during the addition. After the precipitation stir briskly once more and then allow to stand at least 3 hours. Wash with 2.5 per cent ammonia till the chlorin reaction disappears, dry the filter and introduce into a well-cleaned crucible which has been thoroughly ignited. Place the lid at an angle, carbonize the filter, and gradually raise the heat, though not higher than a medium red heat, till the pyrophosphate becomes completely white. When this happens bring the blast into action and

ignite to constant weight. The weight finally accepted must not change even after half an hour's ignition. Upon this requirement especial stress must be laid. Pure magnesium pyrophosphate does not suffer any loss even after several hours' ignition, nor does a good platinum crucible. To the weighed amount of pyrophosphate add the correction given in the table. Multiplication of the sum by 64 gives the amount of phosphoric acid in the weight taken for analysis."

As an additional precaution against loss of phosphoric acid, it is recommended to cover the under side of the crucible lid with magnesium hydroxid, igniting it until magnesium oxid is formed and the weight is constant before the precipitate is ignited.

The direct estimation of citrate-soluble phosphoric acid, B. B. ROSS (*Jour. Amer. Chem. Soc., 16 (1894), No. 5, pp. 304–308*).—The essential features of the article were presented in a paper before the Association of Official Agricultural Chemists at its meeting in August, 1893.[1] The method proposed is as follows:

"After the completion of the 30 minutes' digestion of the sample with 100 cc. of citrate solution, 25 cc. of the liquid is at once filtered out into a dry vessel, preferably into a burette. . . .

"Bring the aliquot, thus measured, into a digestion flask of 250 to 300 cc. capacity, add about 15 cc. concentrated sulphuric acid, and place the flask on a piece of gauze over a moderately brisk flame.

"Within about 8 minutes the liquid will have become quite concentrated and will begin to darken appreciably and at the same time foaming will commence, but will occasion no trouble if an extremely high or a very low flame be avoided.

"After a further lapse of 3 or 4 minutes the foaming ceases and the contents of the flask appear quite black; about 1 gm. of mercuric oxid or metallic mercury is now added and the digestion continued over a high flame.

"The operation can be readily completed within less than half an hour, and; in many cases, within 25 minutes, a clear and almost colorless liquid being obtained.

"After cooling, the solution is washed into a beaker, ammonia is added in slight excess, the solution acidified with nitric acid, and the regular molybdate method followed, after addition of ammonium nitrate.

"In case as large an amount as 50 cc. (corresponding to 1 gm. of the sample) of the filtrate from the citrate treatment is employed, 10 cc. of strong sulphuric acid is at first added and the digestion conducted in a flask of 350 to 500 cc. capacity; after the contents of the flask have blackened and the foaming has progressed considerably, the flask is removed from the flame and 15 cc. more of sulphuric acid is added and the flask and contents heated with a low flame for 2 or 3 minutes; mercuric oxid is next added and the digestion is completed as before described."

The results obtained by this method in a series of determinations by R. E. Blouin agree well with those obtained by the "difference" or official method. The use of the Gunning modification of the Kjeldahl method proved impracticable on account of excessive frothing

Some sources of error in our methods of determining potash in fertilizers and German potash salts, N. ROBINSON (*Jour. Amer. Chem. Soc., 16 (1894), No. 6, pp. 364–372*).—In this paper, read before the World's Congress of Chemists at Chicago, sources of error in the

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[1] See Proceedings of the Tenth Annual Convention of the Association of Official Agricultural Chemists, U. S. Dept. Agr., Chemical Division, Bul. 38, p. 16 (E. S. R., 5, p. 510).

official (the Lindo-Gladding and the alternate) and Stassfurt or Anhalt methods are pointed out. An error common to all is due to the tendency of the precipitates (particularly barium sulphate) thrown down in the course of the method to occlude a certain amount of potash. In addition to this, in the Lindo-Gladding method the alcohol washings remove some of the potash. With the use of the ammonium-chlorid solution it is claimed that a double decomposition results by which the potash of the potassium-platinic chlorid is replaced by ammonia. Moreover the same change occurs when the ammonium-chlorid solution is saturated with potassium-platinic chlorid. By following the official directions an ammonium-chlorid solution was obtained which contained "about as much potash in the form of chlorid as platinic-chlorid." The author's observations indicate, moreover, that the potassium-platinic chlorid obtained by this method is never strictly pure. "In addition to ammonium-platinic chlorid, calcium and magnesium sulphate, and sometimes other impurities, are almost certain to be present. . . . The alternate method is to a certain extent liable to the same objection as the Lindo-Gladding. Most of the loss here comes from the occlusion of potash in the barium sulphate."

The German method is believed to require less manipulation, and after facility in its use is acquired is considered preferable to the other methods. The author is "convinced, however, that it is chargeable with the same essential defects as the Lindo-Gladding and the alternate methods."

Tables are given which show the amounts of potash recovered from the alcohol and ammonium chlorid washings in the Lindo-Gladding method and from the ammonia and ammonium oxalate and barium sulphate precipitates in the alternate method. The average loss to each 1 per cent of potash was found to be 0.029 per cent.

The quantitative determination of carbohydrates, E. SCHULZE (*Chem. Ztg., 18 (1894), No. 29, pp. 527, 528*).—Although cane sugar, milk sugar, and starch can be quantitatively determined by inversion with dilute mineral acids and titration with Fehling's solution, it is explained that this method does not give exact results except when all the prescribed conditions are carefully observed, and presents serious difficulties when a mixture of carbohydrates is present, for the following reasons:

(1) The inversion does not progress with equal rapidity with different sugars; even between carbohydrates, which are otherwise similar, there are considerable differences.

(2) The inversion is often accompanied by a change known as "reversion," through which complex compounds are produced, the majority resembling disaccharids or dextrins.

(3) By continued heating with dilute H_2SO_4 or HCl the glucoses are gradually decomposed, forming humin substances and certain acids (levulinic, formic, etc.).

(4) The amounts of different glucoses required for the reduction of a definite amount of Fehling's solution are not the same, and in order to accurately estimate the glucose content of a solution one must have definite knowledge as to the kinds of glucoses in the solution. If the inversion yields dextrose alone, the titration will give quantitative results; but if it yields levulose, alone or mixed with other glucoses, the quantitative determination is difficult. In this case the inversion must be performed by heating for a short time with very dilute acid, as in the case of cane sugar; by inversion with stronger acid the levulose will be partially decomposed.

The exact determination of the carbohydrates by the above method in vegetable substances containing raffinose, stachyose, or lupeose is practically impossible. Approximately accurate results may be obtained by inverting a definite quantity of the vegetable extract and an equivalent quantity of the pure carbohydrate under exactly the same conditions, and then titrating both with Fehling's solution. Assuming that the carbohydrate behaved the same in the pure solution as in the vegetable extract, the amount of the carbohydrate may be approximately calculated from a comparison of the two results.

The difficulties are nearly insurmountable when a vegetable extract contains a number of carbohydrates which do not invert with like rapidity, or one of which yields a glucose which resists the action of acid only in a slight degree. For instance, if an extract containing cane sugar and maltose, or trehalose, was heated with an acid, the inversion of the cane sugar would be completed before that of the maltose or trehalose; and if the heating was continued until the latter was inverted, the levulose from the cane sugar would be partially or wholly decomposed. It would thus be impossible to determine the total glucose content from the solution resulting from inversion. Of course, if the amount of maltose or trehalose present was small, the error would be insignificant.

If an extract contains several soluble or insoluble carbohydrates, capable of inversion, error may result from the fact that inversion will usually give a glucose mixture of varying reducing power, according to the amount of different glucoses present. This error will be small, as a rule, since the glucoses known at present do not differ very greatly in reducing power.

On the analysis of the seeds of plants, E. SCHULZE (*Chem. Ztg.*, *18* (*1894*), *No. 43*, *pp. 799–802*).—In the case of both leguminous plants and cereals, the husk, or outer covering of the seeds, and the kernel, differ widely in nutritive value. Consequently the author believes an analysis of these two parts separately gives a better idea of the composition than an analysis of the whole seed. This not only increases the number of determinations, but also the labor of preparing the sample for analysis.

The author reviews and discusses the methods of analysis in the light of recent investigations, giving a large number of references to original papers. In connection with the protein determination he recommends the separation of this into albuminoids and non-albuminoids by Stutzer's method, mentioning that in this division the peptones fall in the group with the amids, etc., which is considered a slight objection to the method. The fat determination should be made in dried material with ether free from water and alcohol, and the residue dried in a current of hydrogen or illuminating gas. The lecithin in the extract should be dissolved out with hot absolute alcohol, the amount calculated from the phosphorous content, and this deducted from the ether extract. This gives an extract composed mostly of glycerids, but containing also cholesterins and sometimes wax-like substances.

The methods of F. Schulze, Hoffmeister, and G. Lange are mentioned as available for the determination of "cellulose," but it is recommended generally to determine "merely the crude fiber" by means of the "common well-known method."

The starch is determined with the aid of malt extract.

The constituents of the nitrogen-free extract soluble in malt extract (starch) and in water (cane sugar, raffinose, lupeose, etc.) are determined separately. The carbohydrates insoluble in water and malt extract (gums yielding mannose, arabinose, xylose, etc.) may be approximately determined by difference.

The organic acids, when precipitable by lead acetate, can be approximately determined by adding lead acetate to the aqueous extract from a known quantity of material, filtering and washing, decomposing the residue with hydrogen sulphide, and then determining the acidity of the solution by titrating with standard alkali. Deducting the sulphuric and phosphoric acids gives the organic acids, which can not be calculated to per cent unless the nature of the acids is known.

In closing, the author calls attention to the fact that the methods at hand for the analysis of seeds are far from perfect, and that the results obtained by them must always be regarded as open to correction when more accurate methods are found.

A simple method for the determination of fat in butter, W. S. SWEETSER (*Pennsylvania Sta. Rpt. 1892, pp. 143–146*).—The method is as follows:

"The sample is melted and then cooled as quickly as possible while being violently shaken. Ten grams are melted and washed into a 200 cc. flask with 76 degree benzin. After shaking well and cooling the flask is filled to the mark with benzin. The contents, after being well mixed, are allowed to settle, and 40 cc. is run from a burette into a weighed platinum dish containing a few grams of asbestos. The solvent is driven off by gentle heat, and the residue dried from 1 to 2 hours at 100° C. and weighed. . . .

"When the curd and ash are to be determined, the fat may be separated by washing it from the residue into the graduated flask by decantation. The residue is then transferred to a Gooch crucible and manipulated as by the official method. A cheaper grade of benzin could probably be used as a solvent."

This method was compared with the official method on 24 samples of butter. The differences in the case of some samples were noticeable, amounting in 9 cases to over 0.5 per cent. Duplicate determinations by the proposed method agreed rather more closely than by the official method.

"The mean of the differences between the two methods is —0.13 per cent, which indicates that by the new method nothing but the fat was in solution. Or it might indicate that by the official method the fat was not completely dried."

Determination of fat in cheese, S. BONDZYNSKI (*Ztschr. anal. Chem., 33, No. 12, pp. 186–189*).—The author has applied the principle of the Schmidt-Bondzynski method for milk analysis (E. S. R., 5, p. 801) to the analysis of cheese, changing only the proportions. In detail the method is as follows: A weighed quantity (amount not stated) of finely ground cheese is placed in the calibrated tube used in the above method and heated with 20 cc. of HCl of 1.1 specific gravity (about 19 per cent) until the cheese is dissolved and the melted fat rises to the surface. The tube is then cooled and about 30 cc. of ether added, which dissolves the fat readily without shaking. The ether-fat layer is separated from the HCl by heating for a time at about 40° C., and this separation is aided by centrifugal treatment. The volume of the ether-fat layer is read off on the scale, 20 cc. of this evaporated in an Erlenmeyer flask, and the result calculated for the whole layer.

The results of parallel determinations agreed well with each other and with the results obtained by extraction in a Soxhlet extractor.

Method of sampling milk for analysis, W. FREAR and J. W. FIELDS (*Pennsylvania Sta. Rpt. 1892, pp. 146, 147*).—In analyzing composite milk samples for nitrogen by the Kjeldahl method, in one case the composite samples were made rather small and the whole quantity analyzed, and in another they were made larger and a subsample taken for analysis, the milk being preserved with corrosive sublimate. The two methods gave equally accurate results, but the analysis was more easily executed with the latter method, which is preferred.

Report of the Chemical Control Station at Alnarp, Sweden, for 1893, M. WEIBULL (*pp. 9*).—The report shows that 755 samples of soils, fertilizers, feeding stuffs, butter, water, etc., and 2,579 samples of milk were analyzed during the year. Of the latter number 2,204 samples were examined for their fat content by the lactocrite method. The new milk analyzed usually contained between 3 and 4 per cent of fat; 92 samples contained 2.6 per cent or less; and 81 samples contained 4 per cent or more of fat. Of the 153 samples of skim milk examined, about 80 were separator skim milk, containing from 0.19 to 0.43 per cent of fat. The skim milk produced by gravity setting gave higher results, the maximum fat content found being 1.12 per cent. The 10 samples of buttermilk analyzed contained from 0.2 to 0.68 per cent of fat.

Two dairy investigations are reported, viz: (1) the application of potassium permanganate for the preservation of samples of milk for

analysis (E. S. R., 5, p. 536); and (2) the method of composite sampling without addition of any preservatives. As the potassium bichromate, according to recent Danish experience, may lead to "certain peculiar mistakes," the author recommends keeping composite samples of milk in a well-stoppered bottle without a preservative, and at the end of 2 to 3 weeks adding a definite small quantity of concentrated ammonia and determining the fat, according to the method described by him (*Milch Ztg.*, 23 (1894), p. 247).—F. W. WOLL.

Miscellaneous chemical work (*Pennsylvania Sta. Rpt. 1892, pp. 135–143, 168–174*).—Analyses of peat, marls, wood ashes, brewers' grains, hominy meal, buckwheat middlings, "Thorley Food," oat dust, albumen curd, casein curd, and the following insecticides: Fostite, par oïdium, and antinonnin. Directions are given for taking and sending various samples.

Report of the Chemical Control Station at Christiania, Norway, for 1893, F. H. WERENSKIOLD.—The report covers 64 pages and gives proof throughout of the increasing usefulness and activity of this young station. Ten hundred and five samples of soils, fertilizers, dairy products, feeding stuffs, etc., were sent in for examination and analysis during the year.—F. W. WOLL.

An introduction to the organic compounds of everyday life, J. T. WILLARD. 12mo., cloth, pp. IV, 203. Published by the author, Manhattan, Kans.: 1894. Noticed in *Jour. Amer. Chem. Soc., 16 (1894), No. 7, p. 502.*

The condition of chemical instruction in the United States, E. A. SCHNEIDER, (*Chem. Ztg., 18 (1894), No. 45, pp. 835, 836*).

Contributions on the chemical composition of pure fruit juices, H. KREMLA (*Ztschr. Nahr. Hyg. Waar., 7, p. 365; abs. in Chem. Centbl., 1894, I, No. 24, p. 1089*).—Analyses of the juices of cherries, currants, gooseberries, wineapples, and melons.

Contribution to the study of albumoses, H. SCHROETTER (*Monat. Chem., 14, p. 612; abs. in Bul. Soc. Chim. Paris, 11–12 (1894), No. 12, pp. 938, 939*).

The natural oxycelluloses, C. F. CROSS, E. J. BEVAN, and C. BEADLE (*Ber. deut. chem. Ges., 27, pp. 1061–1065; abs. in Chem. Centbl., 1894, I, No. 24, p. 1080*).

The natural oxycelluloses, G. DECHALMOT (*Ber. deut. chem. Ges., 27 (1894), No. 11, pp. 1489–1491*).

Concerning the insoluble carbohydrates entering into the composition of Lactarius piperatus, E. BOURQUELOT (*Bul. Soc. Bot. France, 41 (1894), pp. 254–257*).

On the occurrence of cellulose in bacilli and other fungi, I. DREYFUSS (*Ztschr. physiol. Chem., 18 (1894), pp. 358–379; abs. in Bot. Ztg., 52 (1894), pt. 2, No. 13, pp. 195–197*).

On the chemistry of chlorophyll, E. SCHUNCK and L. MARCHLEWSKI (*Liebig's Ann., 278, pp. 329–345; abs. in Chem. Centbl., 1894, I, No. 36, pp. 1158–1160*).

A method for determining quickly lime and magnesia, O. FORTE (*Abs. in Staz. Sper. Agr. Ital., 26 (1894), No. 4, pp. 426–429*).

Detection and estimation of very small amounts of nitrogen acids, G. LUNGE and A. LWOFF (*Ztschr. angew. Chem., 1894, No. 12, pp. 345–350*).

On the Gunning-Kjeldahl method and a modification applicable in the presence of nitrates, A. L. WINTON (*Connecticut State Sta. Rpt. 1893, pp. 171–174*).—This is a reprint from part III of the Annual Report of the station for 1893 (E. S. R., 5, p. 975).

Note on Pemberton's method of phosphoric acid determination as compared with the official methods, W. C. DAY and H. P. BRYANT (*Chem. News, 70 (1894), No. 1806, p. 3*).—Very concordant results were obtained by the different methods on Florida phosphate.

Bartmann's mechanical stirrer for the rapid analysis of phosphatic fertilizers, L. GRANDEAU (*Prog. Agr. et Vit., 58 (1894), No. 25, pp. 890–892, fig. 1*).—A

device for stirring the contents of several beakers at once, devised in the laboratory of the agricultural experiment station of l'Est, is illustrated and described.

A new method for quantitative determination of furfurol and of the pentosans in vegetable materials, C. COUNCLER (*Chem. Ztg., 18 (1894), No. 51, pp. 966–968*).

On the pentoses and pentosans and their estimation by furfurol distillation, B. TOLLENS (*Ztschr. Ver. Rubenz. Ind., 1894, May, pp. 426–437*).—Urges the importance of always determining these in feeding stuffs and recommends the furfurol distillation method for this purpose.

On a method for the fractional precipitation of the albuminoids of blood serum, W. ENGEL (*Arch. Hyg., 20, No. 3, pp. 214–218*).

Notes on the estimation of crude fiber in sugar cane, J. L. BEESON (*Jour. Amer. Chem. Soc., 16 (1894), No. 5, pp. 308–313*).

Apparatus for determining the fat content of liquids, especially the cream content of milk (*Chem. Ztg., 18 (1894), No. 51, p. 973, fig. 1*).

The albuminoids of milk, M. ARTHUS (*Arch. physiol., 4, ser. 5, p. 673; abs. in Centbl. Physiol., 8, pp. 47, 48; and Chem. Centbl., 1894, I, No. 26, p. 1161*).

Behavior of milk toward rennet, R. LEZÉ and E. HILSONT (*Compt. Rend., 118 (1894), p. 1069; abs. in Chem. Ztg., 18 (1894), No. 50, Repert., p. 157*).

Convention of sugar chemists of Austria-Hungary at Graz, June 11, 1894 (*Chem. Ztg., 18 (1894), No. 49, pp. 925, 926*).—The limit of error allowable in the determination of nitrogen in nitrate of soda, and experience with the methods of N. von Lorenz and A. Jolles for the determination of phosphoric acid, were discussed.

On the gravimetric determination of reducing sugars with alkaline copper solution, E. NIHOUL (*Chem. Ztg., 18 (1894), No. 47, pp. 881, 882*).

Control of Fehling's solutions, A. BORNTRÄGER (*Ztschr. angew. Chem., 1894, No. 12, p. 351*).

On the qualitative determination of tanning materials, H. R. PROCTOR (*Jour. Soc. Chem. Ind., 13 (1894), No. 5, pp. 487–493*).—Ten qualitative tests are described and results of these trials on various extracts containing tannin are recorded.

Note on the estimation of tanning matter, H. R. PROCTOR (*Jour. Soc. Chem. Ind., 13 (1894), No. 5, pp. 494–496, fig. 1*).—Recent methods are briefly discussed and attention is especially called to the determination of tannin by shaking the extracts with powdered hide in a "milk-shake" apparatus.

Contributions on the chemistry of tobacco smoke, R. KISSLING (*Arch. Hyg., 20, No. 3, pp. 211–213*).

Progress in the chemistry of tobacco, R. KISSLING (*Chem. Ztg., 18 (1894), No. 51, pp. 968, 969*).—A review.

BOTANY.

Active albumen as reserve material in plants, O. LOEW (*College of Agr., Tokyo, Japan, Bul., vol. 2, No. 1, pp. 23–33*).—The author, associated with T. Bokorny, has already shown[1] (1) that there exists in many plants, apparently in a state of solution, a certain proteid substance quite different from ordinary proteids; (2) that this substance is capable of certain reactions, of which the living protoplasm, on account of its great instability, is incapable, and which neither dead protoplasm nor the known soluble proteids show; (3) that this substance is used up during the growth and multiplication of cells, and that it therefore plays the rôle of a reserve material.

[1] Bot. Centbl., 1889 and 1893; Biol. Centbl., vol. 2; Flora, 1892, p. 117, etc.

The author gives at considerable length the details of his experiments, in which he found that many vegetable objects, algæ as well as parts of higher plants, show under the influence of dilute solutions of coffeïn or antipyrin a great number of minute, transparent, colorless globules that gradually unite, forming larger globules or drops. To these minute globules the author has given the name *proteosomes.* They are found in the vacuole as well as other parts of the cell. *Spirogyra* furnishes a good subject for examination, as the cells will live for some time in the solutions above mentioned. If the objects in which the proteosomes have been formed be taken from the solutions and placed in pure water the globules will disappear as rapidly as the solution is displaced in the cell by osmosis. If the cells are killed by long exposure to the solution or by acids or salts of different kinds, the globules change their properties, showing their close resemblance to the protoplasm of the cell. By a sudden loss of their absorbed water the proteosomes coagulate and become insoluble, showing decisively their chemical changes. Various reactions are given, showing that the proteosomes respond to certain chemicals which have no effect on dead protoplasm or other proteids, and even when killed the proteosomes still are capable of reducing very dilute alkaline silver solutions, the globules turning black.

To demonstrate the fact that the proteosomes are active albumen, the author cultivated *Spirogyra* in two solutions, one containing nitrogen, the other without it. In the latter solution, after 2 or 3 weeks of cultivation, no new albumen having formed, and that previously stored having been used, no proteosomes were formed when subjected to the coffeïn solution. On the contrary, the plants grown in the solution containing nitrogen gave an abundant formation of them.

The presence of active albumen stored up in the higher plants has been demonstrated in numerous cases. It has been found in the leaves of nearly all the insectivorous plants, the subepidermal cells of *Crassulaceæ*, the epidermal cells of *Primula* and *Pelargonium*, the trichomes of *Begonia* and other plants, the petals of *Cyclamen*, *Cornus*, *Tulipa*, and *Epidendron*, the anthers of *Eugenia*, etc.; the pistils of *Crocus*, *Rhododendron*, *Salix*, and *Euphorbia;* the peduncles, petals, and young seeds of *Gentiana*, *Primula*, *Scrophularia*, *Impatiens*, *Pyrus malus*, *Prunus cerasus*, *Viburnum*, *Sorbus aucuparia*, and *Thea chinensis;* the flowers and young leaves of *Rheum*, *Acer*, *Populus*, *Acacia*, *Cratægus*, *Mimosa*, and the nectaria of *Passiflora.* In some plants it is found only in certain stages of development, as in the petals of *Malvæ*, unripe berries of *Symphoricarpus racemosus*, the cotyledons of *Helianthus*, and in the larger cells of *Vallisneria.* It was not found in the leaves and roots of *Poa*, shoots of *Pisum* and *Vicia*, or leaves, stems, and flowers of *Tussilago*, *Ranunculus*, *Veronica*, and *Convallaria.* Its presence in fungi is still problematical, and among algæ, *Spirogyra*, and sometimes *Vaucheria*, are the most notable ones showing this kind of reserve material.

The following are given by the author as the more striking chemical differences between active and passive albumen:

"(1) The power of combining with water is greater with the active than with the passive albumen.

"(2) Coffeïn and antipyrin exert action upon the active, not upon the passive, albumen.

"(3) Alcohol of 10 to 20 per cent, vapors of ether, very dilute acetic acid, change the active b t not the passive albumen.

"(4) Active albumen absorbs ammonia and turns thereby insoluble, while passive albumen remains indifferent.

"(5) Active albumen reduces highly diluted alkaline silver solutions; passive albumen does not."

The rôle of carbohydrates in intramolecular respiration in the higher plants, W. PALLADINE (*Rev. gén. Bot., 6 (1894), pp. 201–209*).—M. Diakonow has shown[1] that certain of the lower fungi are able to give off carbon dioxid when confined in an atmosphere deprived of oxygen, provided they are furnished with some fermentable substance. The same experiments conducted upon phanerogams failed unless the plants contained more or less glucose, a fermentable substance. The author in the present paper proposes to show in what respect the intramolecular respiration of etiolated leaves is dependent on the carbohydrates. One lot of leaves was placed in an atmosphere of hydrogen, while a corresponding lot was detached from the plants and placed in a 10 to 15 per cent solution of sugar after the method of Böhm.[2] Experiments were conducted with etiolated leaves of *Vicia faba*, *Allium cepa*, and *Lupinus luteus*, the details of each of the 10 experiments being given.

The result of the author's experiments agree with those described by Diakonow for fungi. The amount of carbon dioxid given off by etiolated leaves in an atmosphere deprived of oxygen depends on the richness of the solutions of carbohydrates used. The leaves of the bean and lupine, which contain but a trace of carbohydrates, gave off a very insignificant amount of carbon dioxid when placed in the oxygen free-air, and quickly perished. The artificial introduction of sugar into their tissues increased very considerably the amount of carbon dioxid given off, as well as prolonged their life while under these conditions. The very small quantity of gas given off in the first case may not have been normal respiration, but due to the presence of microörganisms in the plant, which, as has already been shown[3], can begin to liberate carbon dioxid within 4 hours after the death of the plant.

Botany of the Death Valley Expedition, F. V. COVILLE (*U. S. Dept. Agr., Division of Botany, Contributions from U. S. National Herbarium, vol. 4, pp. 363, pls. 22, map 1.*)—A report on the botany of the expedition sent out in 1891 by this Department to make a biological survey of the region of Death Valley.

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[1] Ber. deut. Bot. Ges., 1886, p. 411.

[2] Bot. Ztg., 1883, pp. 33, 49.

[3] Johannsen, Bot. Ztg., 1886, p. 762.

In addition to the catalogue of plants and descriptions of new species, the author, in an introductory chapter, gives an account of the itinerary of the expedition, the principles of plant distribution, distribution of plants in southeastern California, characteristics and adaptations of the desert flora, and a comprehensive bibliography. The collection of over 2,000 specimens yielded new species as follows: *Aplopappus interior*, *Aquilegia pubescens*, *Arctomecon merriami*, *Arenaria compacta*, *Astragalus eremicus*, *A. inyoensis*, *A. panamintensis*, *A. virgineus*, *Atriplex tularensis*, *Boerhavia annulata*, *Buddleia utahensis*, *Ceanothus pinetorum*, *Coleosanthus desertorum*, *Cryptanthe recurvata*, *Cymopterus panamintensis*, *Ephedra viridis*, *Erigeron calvus*, *Eriogonum brachyanthum*, *E. nivale*, *Erysimum asperum perenne*, *Frasera tubulosa*, *Gayophytum eriospermum*, *Isomeris arborea globosa*, *Lepidospartum striatum*, *Lotus argensis*, *Lupinus covillei*, *Mentzelia reflexa*, *Mohavea breviflora*, *Navarretia setiloba*, *N. setosissima punctata*, *Nemophila spatulata*, *Œnothera xylocarpa*, *Penstemon fruticiformis*, *Phacelia hispida brachyantha*, *P. perityloides*, *Phleospora bigeloviæ*, *Phlox austromontana*, *Phyllogonum luteolum*, *Potentilla eremica*, *P. purpurascens pinetorum*, *Sarcobatus baileyi*, *Saxifraga integrifolia sierræ*, and *Uromyces bicolor*.

Various groups were distributed to specialists for identification, and are reported in their proper places.

Manual of the Phanerogams and Pteridophytes of western Texas, J. M. COULTER (*U. S. Dept. Agr., Division of Botany, Contributions from U. S. National Herbarium, vol. 2, No. 3, pp. 347–588*).—This is the concluding part of the Manual of Phanerogams and Pteridophytes of western Texas, the other parts having been noticed in E. S. R., 3, p. 103, and 4, p. 84. This part includes the *Apetalæ*, *Monocotyledonæ*, *Coniferæ*, and *Pteridophyta*. The *Juncaceæ* were prepared for this manual by F. V. Coville, the genus *Carex* by L. H. Bailey, the *Gramineæ* by L. H. Dewey, and *Pteridophyta* by L. M. Underwood. The disposition of species is as follows: *Apetalæ*, 21 orders, 85 genera, 377 species; *Monocotyledons*, 23 orders, 157 genera, 651 species; *Gymnosperms*, 2 orders, 5 genera, 21 species; and *Pteridophyta*, 7 orders, 19 genera, 54 species, making a grand total of plants for the region covered by this manual of 134 orders, 812 genera, and 2,793 species.

A practical guide for the preparation and care of herbarium material, C. DUVAL (*Paris: Garnier Bros., 1894, pp. 157.*)—The work is divided into two parts, the first dealing with phanerogams and the second part with cryptogams. The second part was prepared with the collaboration of various specialists in the larger groups. Full directions are given for collecting, preparing, determining, and caring for all kinds of herbarium material.

A study of henna, EHRMANN (*Jour. Pharm. et Chim., 14 (1894), ser. 5, No. 12, pp. 591–598, fig. 1*).—A report on botanical, micrographical, and chemical studies, as well as on its properties and uses among the Arabians.

New proof of the correctness of the law of the arithmetical mean, NOWACKI (*Deut. landw. Presse, 21 (1894), No. 52, pp. 518, 519*).—A discussion of the relations between the lengths of the adjacent internodes in the straw of small grains.

Concerning the periodicity of root growth in plants, A. WIELER (*Forst. Centbl., 16 (1894), No. 7, pp. 333–349*).

On the germination of the pollen grain and the nutrition of the pollen tube, J. R. GREEN (*Ann. Bot., 8 (1894), pp. 225–228*).

On the study of gaseous exchange between living beings and surrounding air, BERTHELOT (*Ann. Chim. et Phys., 7 (1894), No. 2, pp. 289–292*).

The fixation of free nitrogen by plants, H. L. RUSSELL (*Bot. Gaz., 19 (1894), pp. 284–293*).—A résumé.

Intercellular communications of lichens, G. POIRAULT (*Compt. Rend., 118 (1894), No. 24, pp. 1362, 1363*).

Concerning intramolecular respiration, N. CHUDIAKOW (*Landw. Jahrb., 23 (1894), No. 2 and 3, pp. 333–389, figs. 2*).

The energy of living protoplasm, O. LOEW (*College of Agr., Tokyo, Japan, Bul., vol. 2, No. 1, pp. 1–22*).

Functional individuality of protoplasm and nucleus, J. DEMOOR (*Bul. Soc. Micr. Belgium, 20 (1894), pp. 36–40; abs. in Bot. Centbl., 59 (1894), No. 1 and 2, pp. 24–25*).

Pistillodia of Podophyllum stamens, B. D. HALSTED (*Torrey Bul., (1894), No. 21, p. 269*).

The structure of the pedicel of the teleutospores of Puccineæ, P. VUILLEMIN (*Bul. Soc. Bot. France, 41 (1894), No. 4, pp. 285–290*).—A description of a new species of *Uromyces*, *U. verrucipes*, accompanies this article.

Concerning the coloring matter of sunflower seed, A. FAMITZIN (*Arbeit. bot. lab. Akad. St. Petersburg, (1893), No. 6, pp. 3; abs. in Bot. Centbl., 58 (1894) No. 11, p. 379*).

Purpose and result of plant acclimatization, GUNTHER, BECK, and MANNAGETTA (*Wiener ill. Gart. Ztg., 19 (1894), No 4, pp. 144–154*).—A lengthy semipopular article on the subject.

A method of cultivating anaërobic bacteria, W. LUBINSKI (*Centbl. Bakt. u. Par., 16 (1894), No. 1, pp. 20–25, figs. 4*).

On the poisonous action of dicyanogen, O. LOEW and M. TSUKAMOTO (*College of Agr., Tokyo, Japan, Bul., vol. 2, No. 1, pp. 34–41*).—Effect of dicyanogen on various plants and low animals as compared with effect of prussic acid.

METEOROLOGY.

Meteorology, W. FREAR and W. S. SWEETSER (*Pennsylvania Sta. Rpt. 1892, pp. 147–152, 161–167, 175–204*).—The meteorological work of the Pennsylvania Station during 1892 was along the same lines as in previous years (E. S. R., 5, p. 30), and included general observations on atmospheric phenomena, sunshine records, and soil temperatures. Monthly summaries of meteorological observations and weekly crop reports are given in the body of the report, and the detailed record of daily observations in an appendix.

The summary for the year is as follows:

Summary of meteorological observations.

	Year 1892.	Winter (Oct., 1891, to Mar., 1892).	Growing season (Apr. to Sept., 1892).
Barometer (inches):			
Mean	30.027		
Highest	30.622 (Jan. 10)		
Lowest	29.285 (Jan. 6)		
Temperature (° F.):			
Mean	47.7	34.7	62.8
Highest	95 (July 26)		95 (July 26)
Lowest	−3 (Jan. 20)	−3 (Jan. 20)	24 (Apr. 25)
Annual range	98		
Mean daily range	18.2		19.9
Greatest daily range	39 (Feb. 18)		36 (May 1)
Least daily range	3 (Jan. 6)		
Mean daily relative humidity (per cent)	80.1		75.02
Rainfall (inches):			
Total	41.08	20.93	26.82
Greatest monthly	7.36 (June)		
Greatest daily	2.24 (June 27)		2.24 (June 27)
Number of days on which 0.01 inch or more of rain fell	139		79
Mean percentage of cloudiness	62.3		55.87
Number of days on which cloudiness averaged 80 per cent or more	161	98	63
Average hours of sunshine per day			6 h. 47 min.
Wind (miles):			
Total movement	34,810		
Maximum velocity	29 (Jan. 26)		
Greatest daily movement	445 (Dec.)		
Last frost in spring			May 8
First frost in fall			Sept. 2

Principal periods of crop development.

Wheat:
Sown September 11–17, 1891.
Harvested July 10–17, 1892.

Corn:
Planted May 2.

Oats:
Sown April 14–21.
Ripe July 31.
Harvested August 7–14.

Grass:
Haying begun June 26–July 10.

"The winter of 1891–'92 had almost exactly the same mean temperature as the winter preceding, but had a minimum temperature a few degrees lower. Though it was slightly less cloudy, it had a snowfall nearly twice as great, and the snow covered the ground for a longer time, especially during March, although the early winter was open and trying to wheat. Frost occurred on May 8, somewhat injuring the cherries.

"During the growing season the temperature was a trifle higher than in 1891, but the cloudiness, rainy days, rainfall, and relative humidity were considerably higher. The amount of sunshine was very nearly the same. Snow fell to the depth of 5½ in. on April 13, retarding oats sowing, a cold wave prevailing at that time. In latter May cold weather prevailed; heavy rains in the middle of June lodged grass and grain badly, while hail injured the corn of the neighborhood. July was an excellent growing month. Potatoes and corn were harvested in good condition."

Meteorological summary for Ohio, 1893 (*Ohio Sta. Bul. 52, pp. 145–156*).—Notes on the weather and tabulated daily and monthly summaries of observations at the station on temperature, precipitation, cloudiness, direction of the wind, etc., are given; and for comparison similar data for previous years and for other parts of the State are added. The following is a summary of results:

Summary of meteorological observations.

	For the experiment station.		For the State.	
	1893.	For 6 years.	1893.	For 11 years.
Temperature (° F.):				
Mean	49.3	49.7	50.1	50.
Highest	[1]95	99 (Aug. 8, '91)	102 (June 19)	108 (July 18, '87)
Lowest	—9 (Jan. 11)	—20 (Jan. 20, '92)	—24	—34 (Jan. 25, '84)
Range	104	119	126	142
Mean daily range	20.2	19.6	21.7	20.8
Greatest daily range	45 (Aug. 9)	46 (July 7, '92)	54.6	38.5 (Jan. 30, '85)
Least daily range	[2]3	2 (Jan. 6, '89)	1	0.5 (Dec. 23, '83)
Clear days	96	112	122	113
Fair days	164	124	123	123
Cloudy days	105	120	120	130
Days rain fell	129	127	113	130
Rainfall (inches):				
Total	40.58	41.69	39.63	39.4
Greatest monthly	6.33 (Feb.)	7.89 (June, '92)		
Least monthly	1.38 (July)	0.37 (Oct., '92)		
Mean daily			0.11	0.11
Direction of wind	SW.	S.	SW.	SW.

[1] July 7, 25; Sept. 7.

[2] Jan. 24, Feb. 11, May 26.

Meteorological observations for 1893, D. B. BRACE (*Nebraska Sta. Bul. 33, pp. 115–128, 142*).—Tabulated daily and monthly summaries of observations on temperature, pressure, humidity, precipitation, wind movement, etc., are reported. The summary for the year is as follows: *Pressure* (in.).—Highest, 31.09; lowest, 29.05; mean, 30.05; range, 2.04; greatest daily range, 0.91. *Air temperature* (° F.).—Maximum, 98.7; minimum, —17; mean, 49.84; range, 115.7; greatest daily range, 46.8. *Humidity.*—Mean relative, 68.7. *Precipitation* (in.).—Total precipitation, 20.08; total snowfall, 15.7; number of days on which 0.01 of rain or melted snow fell, 58. *Weather.*—Number of clear days, 165; number of fair days, 123; number of cloudy days, 77. *Wind.*—Total movement (miles), 117,195; maximum velocity, 85; average velocity, 13.38.

A colonial weather service, A. MCADIE (*Pop. Sci. Monthly, 1894, July, pp. 331–337, figs. 2*).—The history of weather forecasting is reviewed, and it is suggested that by means of the telautograph it may be possible to keep simultaneous records and draw weather maps at the same time in all the countries of the world.

Meteorological observations at Massachusetts State Station (*Massachusetts State Sta. Bul. 52, p. 1*).—Notes on the weather and a tabulated summary of observations on temperature, precipitation, and direction of wind for the 5 months ending May 31, 1894.

Meteorological observations at the Massachusetts Hatch Station (*Massachusetts Hatch Sta. Met. Buls. 61–66, pp. 4 each*).—Daily and monthly summaries of observations at the meteorological observatory of the station during January, February, March, April, May, and June, 1894.

Meteorological summary for North Carolina for April and May, 1894, H. B. BATTLE, C. F. VON HERRMANN, and R. NUNN (*North Carolina Sta. Met. Buls. 55 and 56, pp. 55–68, 71–84*).—Notes on the weather, and daily records and a monthly summary of observations by the State weather service coöperating with the Weather Bureau of this Department.

Monthly Weather Review (*U. S. Dept. Agr., Weather Bureau, Weather Review, 22 (1894), 1, pp. 45, charts 6; 2, pp. 51, charts 6; 3, pp. 49, charts 7*).—These numbers are devoted exclusively to the usual topics.

SOILS.

Various studies on the arable soils of the Pas-de-Calais, A. PAGNOUL (*Terres Arables du Pas-de-Calais, Arras: 1894, pp. 128, fig. 1, map 1*).—This is an elaborate report on investigations of the soils of the region of Pas-de-Calais commenced in 1886, and includes descriptions of methods, tabulated chemical and mechanical analyses of 97 soils with detailed descriptions of samples, accounts of investigations on the humidity and absorptive power of soils and the changes which salts undergo in the soil, and practical conclusions deduced from the investigations.

Methods.—In sampling, a field was selected which was typical of one of the classes of the soil of the territory examined and samples were taken as a rule down to a depth of 20 or 30 cm. at 10 different points, although care was taken not to go below the surface soil in any case. At the same time data relating to the agricultural value and adaptability of the soil were collected.

For analysis, the air-dried soil was sifted through a sieve containing 12 meshes to the centimeter (less than one eighth mm. in diameter). The residue left on the sieve was designated gravel, or coarse earth. In order to separate this portion completely the soil was shaken up with water and washed through the sieve.

The method used in the determination of the proportion of clay in soils was as follows: 4 gm. of soil was introduced into a tube divided into centimeters and millimeters, about 35 cm. long and 1 cm. in diameter, a little lime water was added, and the whole shaken up thoroughly. The lime water used for this purpose should register 25° by the hydrometer. The volume of liquid was then increased to 200 mm., shaken again for 2 minutes, and the tube allowed to lie in a slightly inclined position for 6 minutes. The liquid was then found to have cleared appreciably at the top. The line of demarcation between the turbid and the limpid parts was generally well defined. The height of the turbid portion (or "clay degree") was about 25 to 26 mm. with pure sand, 45 to 60 with ordinary loam soils, 60 and above with very heavy soils, and finally about 200 with very strong clays.

For rapidly determining the carbonate of lime in the soil about 10 degrees of the soil was introduced into a special carbonic acid apparatus, which is described and illustrated, and the number of bubbles of gas evolved on the addition of nitric acid counted. By check observations on pure carbonate of lime the weight of carbonic acid corresponding to each bubble was determined and the results applied in the estimation of carbonate in the soil.

Humus was determined by extracting the soil with caustic soda solution and comparing the color of the extract thus obtained with a standard solution of caramel. By this method ordinary soils showed a

"humus degree" of 15 to 25, rich garden soils over 50 and woods earth and peaty soils over 400.

The soils examined were classified into 2 main categories, (1) ordinary soils containing less than 50 per cent of humus, and (2) those containing more than 50 per cent. The first was divided into calcareous, clay, and sandy soils; and each of these further divided into 4 other subdivisions depending upon the relative proportions of lime, clay, and sand. The scheme of classification is explained graphically and in notes and tables.

For determining moisture 5 gm. of soil which had passed through a sieve containing 140 meshes to the square centimeter was dried at 105°.

For the chemical analysis 50 gm. of soil was calcined for 10 to 15 minutes at a moderate red heat in a platinum crucible to destroy all organic matter, and then treated with nitric acid by gently boiling in a flask with condenser for 1 hour. The nitric acid was prepared by diluting 50 cc., plus one half the weight in grams of the amount of carbonate of lime previously found in the soil, of nitric acid to a volume of 250 cc. The solution was allowed to cool, filtered, and 100 cc. taken for the determination of phosphoric acid and the same amount for lime and potash.

In the determination of phosphoric acid the molybdate precipitate was obtained in the usual way, dissolved in ammonia, and precipitated with magnesia mixture in the presence of a small amount of citrate of ammonia. The ammonium-magnesium phosphate after thorough washing was dissolved in nitric acid (1 part of HNO_3 to 9 of water), a slight excess of ammonia added, and the solution finally rendered slightly acid by addition of 1 or 2 cc. of acetic acid, using cochineal as an indicator. Phosphoric acid was then determined by means of a standard uranium solution by Halot's method.

In the determination of lime 100 cc. of the original solution was boiled in a flask with a slight excess of ammonia, the precipitate thrown upon a filter and washed with boiling water, the washings being saved. The precipitate was dissolved upon the filter with a boiling mixture of 20 cc. of nitric acid and 20 cc. of water, the solution precipitated again with ammonia, boiled, filtered, and washed 3 times with boiling water, the solution from this operation being added to the washings of the first precipitate.

The lime was precipitated in this solution by means of carbonate of ammonia and weighed as carbonate.

The potash was determined by precipitating with platinic chlorid in the usual way, and then decomposing the double chlorid with formate of soda. The potassium-platinic chlorid was treated with a mixture of 9 parts of alcohol and 1 part of ether until the filtrate was perfectly colorless, the crystals dissolved in boiling water, and the solution gently boiled with 4 or 5 cc. of 15 per cent formate of soda for 15 minutes, adding more formate if the decoloration was not complete. After

the platinum had settled the supernatent liquid was decanted on to a filter, the platinum washed with nitric acid (1 part of acid to 9 of water), and finally with boiling water, dried, and weighed.

At the beginning of the investigations the nitrogen was determined in 10 gm. of the soil by combustion with soda-lime. The Kjeldahl method was adopted afterward as more rapid and equally accurate, the same weight of soil being used as in the other method.

The methods used in some cases for the determination of magnesia by means of uranium solution and of iron by means of potassium permanganate are described in detail.

In determining ammoniacal nitrogen 20 gm. of the air-dried soil was extracted with 100 cc. of distilled water, 50 cc. of the liquid distilled with magnesia, and the ammonia determined in the distillate by means of Nessler solution.

Nitric nitrogen was determined in a similar extract by means of standard diphenylamin and nitrate solutions, and nitrous nitrogen by means of Griess's reagent prepared by dissolving at the boiling point 1 gm. of sulphanilic acid and 1 gm. of naphthylamin in 200 cc. of water containing 25 cc. of hydrochloric acid. The coloration observed was compared with that obtained by the use of a standard solution of nitrate of potash.

Various quick methods for determining the amounts of potash, phosphoric acid, and lime soluble in water or weak regeants are also noted.

A method is described of estimating the amount of fertilizing ingredients per hectare of soil, taking account of the inert gravel and coarse soil which are not included in the chemical analysis.

Moisture and absorptive power of soils.—Investigations relating to the moisture of the soil were carried out in vegetation pots at two different periods in the course of the above soil investigations. The more recent of these investigations show that from April 14 to July 18 the subsoil of a bare soil stored up 12,658 liters of water per acre and that it lost 5,813 liters, showing an excess of 6,845 liters, which is greater than the average monthly rainfall during the period. The evaporation from the bare soil from May 4 to July 18 was 19,757 liters, from a covered soil 27,441 liters; but at the same time there was stored up in the subsoil of the covered soil 7,699 liters, as against only 2,716 liters in the subsoil of the bare soil. The subsoil appears to be a reservoir which stores up the excess of moisture in the soil in periods of heavy rainfall and gives it out when needed in periods of drought.

The nature of the substances removed from soils by leaching with city service water and with solutions containing nitrate of soda and superphosphate was studied in the following manner: An iron cylinder 1.2 m. long and 2 dcm. in diameter, terminating in a cone below fitted with a rubber tube and stopcock, was partly filled with washed gravel on which was placed 20 kg. of soil extending to a height of about 1 m. The liquids were poured on to the surfice and after traversing

the soil were collected from the cock below. These solutions were submitted to analysis before and after this operation.

The result shows that the mineral substances especially were rapidly removed. Chlorin was promptly washed out. Sulphuric acid at first appeared in the drainage water, but disappeared after 10 days. The proportion of this substance increased after the addition of saline solutions. The proportion of organic matter was considerable at first, but gradually decreased. Organic and ammoniacal nitrogen were always found in appreciable quantities. Nitric nitrogen was washed out by pure water to a moderate extent, but when a solution of nitrate of soda was added this salt appeared immediately in the drainage water. Only a trace of phosphoric acid was removed from the soil by pure water, but when superphosphate was added the proportion was considerably increased. Potash was washed out promptly and the quantity was sensibly increased by adding solutions containing superphosphate.

The changes which certain chemical compounds undergo in the soil were also investigated. The method used was as follows: 100 gm. of the soil was shaken up with 500 cc. of a solution containing a few decigrams of the salt, allowed to stand 15 hours, and filtered, the solution being analyzed before and after this treatment.

With the chlorids of potash, soda, and ammonia it was found that the proportion of chlorin remained unchanged, but that the bases had in every case been replaced by lime. Chlorid of calcium and sulphate of calcium were unchanged. With sulphate of potash, sulphate of ammonia, and sulphate of iron the sulphuric acid was not retained, but with the first two the bases were replaced by lime, and with the third by lime and nitrogen. With sulphate of soda the sulphuric acid was not fixed and the soda was not replaced by lime to any appreciable extent. The results with phosphate of potash show that a large proportion of both potash and phosphoric acid was fixed in the soil and that there was no appreciable replacement of potash by lime. The results indicate, therefore, that phosphate of potash may be used on calcareous soils without danger of loss of its two fertilizing constituents in the drainage water. A large proportion of the phosphoric acid of phophate of soda was fixed, and there was very little, if any, replacement of soda by lime. When a solution of superphosphate was used the phosphoric acid was largely fixed and the proportion of lime in the filtrate was increased, probably on account of the sulphate of lime in the superphosphate. From the solution of phosphate of ammonia a large part of the phosphoric acid and about half of the ammoniacal nitrogen was fixed, and there was no substitution of lime for the latter. With nitrate of potash the nitrogen was completely removed in the final solution, but a considerable proportion of the potash was retained, its place being taken by lime. Similar results with reference to the nitric nitrogen were obtained with a solution of nitrate of soda, but the soda was not replaced to any appreciable extent by other bases. Nitrate of

lime was not changed in any respect. With nitrate of ammonia none of the nitric nitrogen, but a considerable proportion of the ammoniacal nitrogen was fixed, and the final solution appeared to contain a mixture of nitrate of ammonia and nitrate of lime. The soil fixed a considerable proportion of the potash of carbonate of potash, and it was replaced to some extent by lime. Carbonate of soda was but slightly changed by contact with the soil. With the solution of bicarbonate of lime an appreciable amount of potash and a considerable excess of lime were removed from the soil. Carbonate of ammonia appeared to be retained by the soil without undergoing any transformation.

Practical deductions regarding the use of fertilizers.—As regards the bearing of chemical analysis on the use of fertilizers on soils, it is stated that while no fixed rules can be laid down, it appears that a soil which contains less than 5 per cent of carbonate of lime and more than 60 "degrees" of clay would be benefited by an application of lime. The amount of lime applied should vary with the proportion of clay. Soils rich in humus should be liberally limed, and in peaty soils this substance is absolutely necessary to productiveness. The use of sulphate of iron to render lime soluble is also suggested, but this substance should be used only on soils comparatively rich in lime.

Soils containing less than 0.1 per cent, or 4,000 kg. per hectare, of phosphoric acid, as indicated by the experiments of Déherain, Joulie, Dellisse, and the author, will probably be benefited by applications of phosphates; but, as pointed out by Müntz, this limit should not be considered fixed, depending largely upon the assimilability of the phosphoric acid in the soil. As to the form in which the phosphate should be applied, it is stated that if the soil is calcareous superphosphates may be used with advantage. If, however, the soil contains less than 1 per cent of lime, superphosphates are likely to be injurious, and a phosphate containing free lime, such as Thomas slag, should be used. Precipitated phosphates are well adapted to all soils which need phosphoric acid, but appear to produce best results on those which contain small amounts of lime. The natural phosphates are used to best advantage on humus soils, and should be applied only in fine ground condition.

In regard to the use of potash, less definite statements can be made than respecting phosphoric acid. The author's investigations indicate that 0.25 per cent, or 10,000 kg. per hectare, is the limit, above which applications of potash salts will not prove profitable. It appears that plants have especial power of assimilating potash in insoluble forms, and that therefore it is not always necessary to supply this element in the form of soluble salts.

The normal proportion of nitrogen in good soils is stated to be about 0.1 per cent, or 4,000 kg. per hectare. Whether soils containing this proportion of nitrogen will be benefited by applications of nitrogenous fertilizers will be determined largely by the condition of the nitrogen in the soil and the demands of the plant cultivated. This figure is given

as a limit, below which applications of nitrogenous fertilizers are almost always indispensable.

As regards the form of nitrogenous fertilizers adapted to different kinds of soil, it is stated that sulphate of ammonia decomposes readily in highly calcareous soils, and is therefore subject to loss of nitrogen in such cases. To such soils organic nitrogen is especially applicable. This form is also adapted to very light sandy soils, in which the nitrates would be rapidly carried away in the drainage water. For ordinary loam soils nitrate of soda is a good form of nitrogen, provided it is applied fractionally as required by the plant at different stages of growth.

Barnyard manure appears to be adapted to all kinds of soils. To light soils and calcareous soils it supplies nitrogen in organic form, and to heavy soils it furnishes nitric nitrogen, since, from the nature of the material, it furnishes nitrogen in three forms, besides supplying a considerable amount of mineral matter and increasing the humus content of the soil. The very qualities, however, which make this material so generally applicable may become sources of loss on certain soils. The ammoniacal nitrogen may be lost in very calcareous soils and the nitric nitrogen may be washed down by rains into the subsoil of very light soils. If nitrification is too slow, plants suffer; if it is too rapid, the excess of nitrate may be injurious to the plant or may be lost in the drainage. The rational use of manure, therefore, in ordinary culture is attended with more difficulties than that of chemical fertilizers.

Soil temperatures, D. B. BRACE (*Nebraska Sta. Bul. 33, pp. 129–141*).—Tabulated summaries of daily observations during each month of 1893 with soil thermometers at depths of from 1 to 36 in. are reported in connection with the readings of the dry bulb, maximum, and minimum thermometers. The maximum and minimum temperatures during the year at the different depths were as follows:

Maximum and minimum soil temperatures for 1893.

	Maximum.	Minimum.
	° *F.*	° *F.*
Air (5 ft. above the ground)	104.7	—17.5
1 in. below the surface	119.5	—2.5
3 in. below the surface	114.0	—2.5
6 in. below the surface	98.0	5.6
9 in. below the surface	87.0	
12 in. below the surface	81.5	
24 in. below the surface		33.9
36 in. below the surface	70.0	33.4

Soil temperatures, W. FREAR (*Pennsylvania Sta. Rpt. 1892, pp. 153–160, 205–228*).—A record is given of tri-daily observations during 1892 with thermometers at the surface and at depths of from 1 to 24 in. The following is a summary of observations during the growing season:

Soil temperatures, April to September, 1892.

Depth.	Highest.	Lowest.	Daily mean.	Mean daily range.	Greatest daily range.
	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*
At surface	84 (July 29)	32 (Apr. 10–12)	61.4	7.93	20 (May 31, June 13).
1 in. deep	83 (July 29)	33.5 (Apr. 17)	61.0	8.40	17 (May 31).
3 in. deep	79 (July 29)	32.5 (Apr. 1)	61.3	4.82	11 (Apr. 3).
6 in. deep	76.5 (July 26)	32.5 (Apr. 1)	61.1	2.90	8.5 (May 2).
12 in. deep	75 (July 26)	33 (Apr. 1)	60.9	1.30	5.5 (Apr. 3).
24 in. deep	71 (July 29, 30)	34 (Apr. 1, 2)	59.2	0.29	2 (Apr. 3, 4).

Investigations concerning the influence of plant cover on the temperature and moisture of the soil, E. WOLLNY (*Forsch. Geb. agr. Phys., 27 (1894), No. 1 and 2, pp. 153–202*).

A preliminary series of experiments toward the amelioration of alkaline soils, F. T. SHUTT (*Trans. Roy. Soc. Canada, 1893, pp. 17–23, pl. 1*).—Analyses having shown the presence of magnesium sulphate in samples of alkali soils from Manitoba, experiments were undertaken which showed that the addition of as much as 5 per cent of magnesium sulphate to otherwise fertile soil prevented the growth of peas and corn. Carbonate of lime appeared to correct the alkalinity of these soils to some extent, though slowly, while lime was still more effective.

Pentosans in soils, G. DECHALMOT (*Amer. Chem. Jour., 16 (1894), No. 3, p. 229*).—The results of determinations of humus and pentosans in three samples of soils are given as follows:

Pentosans in soils.

Kind of soil.	Humus.	Pentosans.	Pentosans in humus.
	Per cent.	*Per cent.*	*Per cent.*
Wood soil	23.42	0.75	3.2
Garden soil	9.85	0.39	4.0
Poor sandy soil	2.68	0.04	1.5

The presence of pentosans in soils is due to their strong resistance to putrefaction. Their occurrence in humus soils has already been noted by A. Hèbert (E. S. R., 4, p. 87).

The geological survey of England and Wales (*Jour. Roy. Agr. Soc. England, ser. 3, 5 (1894), No. 18, pp. 386–394*).—Excerpts bearing on agricultural soils.

FERTILIZERS.

The action of the gaseous decomposition products of decaying organic matter on phosphoric acid and phosphates of lime, J. H. VOGEL (*Berlin: Paul Parey, 1893, pp. 66*).—This is a second report[1] on investigations undertaken originally to determine (1) how much nitrogen may be fixed by gypsum alone and mixed with free or water-

[1] The first was published in Jour. Landw., 36 (1888), pp. 247–278.

soluble phosphoric acid (superphosphate-gypsum, plain superphosphate, etc.) when an excess of nitrogen as free ammonia or carbonate of ammonia is present, and (2) in what form the phosphoric acid is after the action of the ammonia in either case. The method employed in the latter investigations was in general as follows: Four grams of the phosphate (with or without gypsum) was shaken up with a little water in a liter flask, decomposed either with ammonia water or a solution of carbonate of ammonia or a mixture of the two, and sufficient water added to make the volume 300 cc. After standing 24 hours the flask was filled to the liter mark, digested for 2 hours, and filtered. The phosphoric acid, sulphuric acid, and lime in the filtrate were determined. Five portions of 100 cc. each of the filtrate were evaporated to dryness in platinum dishes, and after heating one half hour at 100° C. (which expelled excess of carbonate of ammonia and moisture) the residues were weighed. Two of these residues were taken up in water, distilled with soda solution, and the ammonia in the distillate determined by titration with sulphuric acid. The total amount of ammonia present in the filtrate was determined by direct distillation of 100 cc. of the filtrate with soda solution. The other three residues were heated over the naked flame at a temperature below glowing. The residue was again weighed and its content of phosphoric acid and sulphuric acid determined. Finally, 10 to 20 cc. of the filtrate was evaporated and the residue examined under the microscope.

The object of these operations was to determine (1) how much of the ammonia present in the filtrate was combined with phosphoric acid and how much with sulphuric acid, (2) how much of the phosphoric acid was in the form of monocalcium phosphate and how much in the form of phosphate of ammonia, and (3) whether gypsum was present and to what extent.

These objects, it is claimed, were attained (1) by determining the sulphuric acid, phosphoric acid, and lime in the above filtrate; (2) by making the same determinations in the evaporated residue, in which there could only be sulphuric acid, phosphoric acid, ammonia, and lime, possibly combined in hydrated monocalcium phosphate, the three phosphates of ammonia, gypsum, and sulphate of ammonia, and (3) by driving off over the flame the phosphates of ammonia, sulphate of ammonia, the water of crystallization of the gypsum, and the water of constitution of the monocalcium phosphate.[1]

This method was employed in numerous experiments testing the influence of ammonia or ammonium carbonate on (1) free and water-

[1] Immendorf argues that under the treatment to which the residues are subjected quite a different series of salts is formed; that the reaction under these conditions is much more complex, and that it is impossible to draw any conclusions from the composition of the ignited residue as to that of the dried residue or from the composition of the latter as to that of the filtrate (p. 129).

soluble phosphoric acid in the presence of gypsum; (2) dicalcium and tricalcium phosphates; (3) preparations containing gypsum and mono, di, and tri phosphates of lime, as well as of iron and alumina; (4) the influence of gypsum on phosphate of ammonia, and (5) the influence of carbonate of ammonia on free and water-soluble phosphoric acid as free as possible of gypsum.

It is claimed that the results show that under the above conditions the soluble phosphoric acid present was largely converted to the citrate soluble or insoluble forms, while a certain portion still remained in the form of soluble phosphate of ammonia. The greater part of the ammonia was combined with sulphuric acid. Gypsum at ordinary temperatures in the presence of water converts monophosphate of ammonia into monophosphate of lime, diphosphate of ammonia into diphosphate of lime, and triphosphate of ammonia into triphosphate of lime, at the same time forming sulphate of ammonia. Where precautions were taken to have the solutions as free as possible from gypsum much less soluble phosphoric acid was transformed to the difficultly soluble forms than where it was present in large amounts. The application of these methods and results in studying the reversion of soluble phosphoric acid by the use of various preservatives in the manure heap is briefly pointed out.

On the action of potash salts in the soil, M. HOLLRUNG (*Fühling's landw. Ztg., 43 (1894), No. 13, pp. 415–417*).—In the report for 1893 of the Experiment Station for Nematode Control at Halle the author reports the results of pot experiments to determine the action of the various constituents of potash salts in the soil as follows:

(1) The commonly applied Stassfurt potash salts, such as kainit, carnallit, kieserit, artificial carnallit, as well as calcined manure salts, possess a comparatively high capacity for absorbing the moisture of the air and returning it to the soil. This property is possessed in a less degree by sulphate of potash, double sulphate of potash and magnesia, carbonate of potash and magnesium, and chlorid of sodium. Rock salt, sylvinit, and calcined kieserit occupy a middle position in this respect.

(2) The most active of the associated salts are chlorid of magnesium, sulphate of magnesium, and chlorid of sodium.

(3) It is doubtful whether the mitigation of "beet sickness" by the application of potash salts in dry seasons is to be exclusively attributed to the hygroscopic properties of the associated salts.

(4) In dry weather certain potash salts, such as kainit and carnallit, and rock salt, improve the texture and fineness of the soil. Sulphate of potash is entirely inactive in this respect.

(5) During dry periods soils fertilized with kainit, carnallit, rock salt, chlorid of sodium, and also with kieserit, artificial carnallit, and calcined manure salts eagerly seize upon atmospheric precipitation and

store up the water in the lower layers of the soil. Soils containing sulphate of potash behave in this respect like soils containing no potash salts, which drink up the rain very slowly.

(6) In dry seasons the improvement of the mechanical condition of the soil undoubtedly does more to mitigate beet sickness than the hygroscopicity of the associated salts of the potash fertilizers.

The production of manure by the horse, H. P. ARMSBY (*Pennsylvania Sta. Rpt. 1892, pp. 79–84*).

Synopsis.—Observations on a number of horses during 10 days indicate that, making allowance for manure dropped outside of the stable, a horse annually produces about 12,500 lbs. of fresh manure, which can be saved, and requires for bedding 2,500 lbs. of straw. A ton of wheat straw economically used as bedding for horses may result in 6 tons of fresh manure, but is not likely in general practice to furnish more than 5 tons, and much less if few animals are kept or the manure infrequently removed.

In order to secure data for an answer to the question whether it is profitable for farmers to "haul their straw to town or city stables and take the resulting manure in payment," two experiments were carried out.

"In the first of these a stable of 8 horses—4 mares and 4 geldings—was experimented upon. At the beginning of the experiment they were bedded with fresh wheat-straw, and every morning as much of this as was wet or soiled was removed and replaced by fresh straw in the evening. The animals stood on a clay floor, and were in their stalls, on the average, 18 hours out of the 24. The amount of straw used for the 8 horses during the 10 days was 1,238 lbs., which is equivalent to 5,648 lbs. per horse per year. The second experiment corresponded more nearly to the conditions likely to prevail in city and town stables. It was made upon 7 of the 8 animals which formed the subject of the first experiment, viz, 3 mares and 4 geldings. The soiled bedding was removed daily, but that which was simply wet was spread out and allowed to dry and used over again. In other words, the straw was used as economically as possible. There was used in this way for the 7 horses in 10 days 483 lbs. of straw, equivalent to 2,519 lbs. per horse per year. The horses were in their stalls, on the average, 17.8 hours out of the 24. If we may assume the conditions of this second experiment to have been similar to those which prevail in city stables, we may take as the basis of our calculations a consumption of 2,500 lbs. of straw per horse per year for bedding purposes."

It is estimated that each horse produces annually 12,667 lbs. of fresh manure which can be saved (deducting amount dropped while at work), worth \$13.65. For the 2,500 lbs. of straw which the farmer carries to the stable he carries away about 15,000 lbs. of manure.

"It is manifestly impossible to make any general statement as to whether such a transaction would be profitable or not. It would depend altogether upon the cost of the hauling, which, again, would depend upon the distance, the facilities for loading and unloading, and the other uses to which the teams could be put."

The following general conclusions are drawn from the data:

"A ton of wheat straw, economically handled, may result in 6 tons of fresh manure, but under no ordinary circumstances will it be more than . . . 5 tons.

"In stables where but 1 or 2 horses are kept, or where the manure is infrequently hauled away, the product might not greatly exceed 2½ tons when the time came to remove it."

Influence of exposure upon the quantity and quality of yard manure, W. FREAR (*Pennsylvania Sta. Rpt. 1892, pp. 85–93*).

Synopsis.—The results of experiments on manure stored in compact heaps in an open dished yard covered with puddled clay, and in a shed open on one side and wholly above ground, while not conclusive, indicate that the average loss for the whole year (summer and winter) was less from the open yard than from the shed.

To aid in determining the comparative economy of storing manure in covered sheds open on one side and wholly above ground, and in open dished yards covered with puddled clay, alternate loads of the manure produced by "a herd of about 25 cows, a few steers and sheep used for digestive experiments, a dozen calves and 10 horses," supplied with the minimum amount of straw and sawdust consistent with cleanliness, were carried to the two heaps. The heaps were compacted by allowing the cattle to run on them an hour or two each day, and uniformity was secured by allowing a few pigs to work them over. When the manure was removed to the field, in August, two sets of samples were taken from each heap, one chopped fine before being taken to the laboratory and the other left unchopped. Manure produced during the fall was treated in the same manner, and when hauled to the field in February was similarly sampled. The samples were submitted to careful analyses. While the results of carefully checked analyses show "that more pains in sampling manure is needful if the results are to be worthy of discussion; that at least triplicate sampling is desirable, and that minute differences are just as probably due to imperfections in sampling as to real differences in the general substance under examination," they also point out, with more or less definiteness, that—

"(1) In both summer and winter the open-yard manure contained most moisture.

"(2) In summer, the greatest loss of organic matter occurred in the exposed heap; in the winter, though the duplicate analyses differ widely in result, the reverse seems true.

"(3) Judging by the residual amounts of potash, the open-yard manure suffered some loss by leaching.

"(4) The results, so far as nitrogen is concerned, agree with those for organic matter. It is therefore evident that under these conditions of exposure, although we have not the data from which to compute the absolute loss of valuable ingredients, the manure lost relatively most from overheating—under the covered shed in the winter, but when exposed to the sun in summer.

"(5) If the expression of value adopted in the foregoing table is accepted,[1] the loss from the covered shed in winter is shown to be greater than the gain from its use in summer, without taking into consideration the factor of the cost of the shed—which may, however, be partly covered by the gain in comfort of the animals protected from excessive heat.

"Since the results of analysis leave so much to be desired in connection with the winter test, this will be repeated."

Experiments made elsewhere are reviewed in which "the results in favor of covering and compacting the manure while fresh are very pronounced, so far as the percentage of loss is concerned. It is to be

[1]Nitrogen 10 cts. per pound and phosphoric acid and potash each 5 cts.

observed, however, that in all these experiments, other than those made at this Station, the quantities of manure used were the minimum or below the minimum of those found in practice; the result can hardly, therefore, be regarded with certainty as fully representing the average."

On the question of the conservation of nitrogen in barnyard manure, H. IMMENDORF (*Jour. Landw., 42 (1894), No. 1, pp. 69–124*).—This is an account of a continuation of experiments already noted (E. S. R., 4, p. 964), undertaken in view of the controversy which the former paper evoked. The literature of the subject is critically reviewed, special attention being given to reports of Müntz and Girard[1] and Holdefleiss, and original investigations are reported under the following heads: By what means are the most important losses of nitrogen occasioned? Where and when in the more common methods of treating manure are the greatest losses of combined nitrogen to be feared? and, How can we reduce as much as possible the loss in the stall and in the dung heap? A report by J. H. Vogel on the action of the gaseous decomposition products of decaying organic substances on phosphoric acid and phosphates of lime (p. 125) is also discussed at some length.

The author concludes that—

(1) The principal cause of loss of combined nitrogen in the ordinary method of handling manure is to be found in the volatilization of ammonia. The evolution of free nitrogen plays a comparatively insignificant rôle.

(2) The evolution of ammonia begins as soon as the manure is voided, and is especially rapid in the liquid excrement. A considerable loss of ammonia, as well as of gaseous nitrogen, may also occur after the manure is thrown in the heap.

(3) Peaty or humus earth may replace with advantage a part at least of the straw generally used as an absorbent. The use of burnt lime or Thomas slag for the purpose of conserving manure should be entirely discarded. Sulphate of iron appears to possess little value for preventing loss of ammonia. It moreover renders the phosphoric acid of the manure insoluble. Gypsum is by no means a perfect preservative, large amounts being necessary to prevent loss of ammonia during energetic ammoniacal fermentation. The reason of this is that it is without effect on the process of fermentation, and it goes into solution too slowly to act with the necessary promptness. It is a matter of indifference whether gypsum is used alone or in combination with dicalcium phosphate; but when mixed with water-soluble phosphoric acid, either as free acid or as monocalcium phosphate, the volatilization of ammonia is reduced to a marked extent, and the acid reaction of the mixture which results has a decided effect in retarding ammoniacal fermentation.

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[1] E. S. R., 4, p. 686.

As regards the use of superphosphate-gypsum, it can not be stated positively that it will completely prevent loss. It is evident, however, that the loss is reduced to the lowest possible limit by the use of this material. On account of its acid reaction the superphosphate-gypsum is specially valuable for neutralizing the alkali of the liquid excrement and thus preventing loss of nitrogen.

Kainit is valuable for checking ammoniacal fermentation. It does not entirely prevent the evolution of free nitrogen under conditions favorable to this reaction, but it appears to retard it to a considerable extent.

The method of investigation by which Vogel arrived at the conclusion that when superphosphate-gypsum or other materials containing soluble phosphate were used as preservatives for manure the phosphoric acid was largely changed to the reverted form is criticised as unreliable, and results of experiments are adduced to substantiate this statement.

On the importance of liming soils deficient in lime, NAEHRIC (*Fühling's landw. Ztg., 43 (1894), No. 12, pp. 381–384*).—Analyses of 23 soils in Schleswig are reported, which show a variation in lime content in the surface soil down to a depth of 200 mm. of from 6,108 to 395,894 kg. of lime per hectare; and experiments during 1893 in liming two of these soils in connection with applications of other commercial fertilizers are also reported. The results show that both sugar beets and beans, even on soils containing considerable percentages of lime, were benefited by applications of this substance.

The after-manuring of soils containing residues of phosphoric acid from previous fertilizing with phosphates, A. EMMERLING (*Landw. Wochenbl. Schles. Holst., 44 (1894), No. 19, pp. 301, 302*).—A brief article in reply to an inquiry of a correspondent, in which the author recommends that soils rich in phosphoric acid from previous applications of phosphates should be fertilized for the following crop simply with nitrates in order to get the highest return from the phosphoric acid present. It is also explained that lime and marl exert a beneficial influence in keeping the soil in a good mechanical condition, thus retarding the conversion of available phosphoric acid into the insoluble phosphates, such as phosphates of iron and alumina. Although these methods will not restore the phosphoric acid to the soluble form in which it was originally applied, they will be very effective in rendering it available to plants.

Methods to determine the availability of organic nitrogen in fertilizers (*Connecticut State Sta. Rpt. 1893, pp. 218–237, pl. 1*).—The results of tests of the method of pepsin digestion, reported in full in the Annual Report of the station for 1885 (pp. 115–131), are briefly reviewed. The conclusion was then drawn that, although this method had decided value for distinguishing between inert and readily available forms of nitrogen in mixed fertilizers, the extent to which it furnished a measure of the agricultural value of the nitrogen "must be determined

by vegetation experiments under accurately controlled conditions, in which nitrogen is supplied in the same materials which have been tested by digestion experiments." In order to further test the method employed in the earlier experiments and determine the efficiency of the pepsin now found in the market, various preliminary experiments with ground bone, dried blood, tankage, dry-ground fish, ammonite, cotton-seed meal, castor pomace, linseed meal, and pea meal, and with various cheap "ammoniates" used as adulterants, some of which contained leather, were undertaken, which showed that the results obtained in 1893 substantially agreed with those obtained in 1885, "and proved that the pepsin solutions used in the two series of trials were alike in their solvent action."

The 125 brands of fertilizers analyzed at the station during 1893 were examined by this method, as follows:

"One gram of the mixed fertilizer was washed on a filter with about 250 cc. of cold water to remove soluble salts and the residue . . . was brought into a 150 cc. flask, with 100 cc. of pepsin-hydrochloric acid solution.

"This solution was prepared by mixing 5 gm. of Parke & Davis's pulverized pepsin (guaranteed to dissolve 2,000 times its weight of coagulated white of egg) in 1,000 cc. of hydrochloric acid diluted to a strength of 0.2 per cent.

"The flasks containing the weighed substance, together with pepsin solution, were kept for 24 hours loosely corked in a water bath having a constant temperature of 40° C.

"At the end of the second, fifth, eighth, and eleventh hours 2 cc. of a 10 per cent hydrochloric acid solution was added.

"After 24 hours' digestion the contents of the flask were filtered and nitrogen was determined, by the Kjeldahl method, in the washed and dried residues."

The results indicate that of the 125 brands 105 were above suspicion (60 per cent or more of nitrogen soluble), 12 near the danger line (50 per cent soluble), and 8 probably contained some comparatively worthless form of organic nitrogen (less than 50 per cent soluble); but "the method can not at present do more than create a strong presumption for or against the quality of the goods."

The amounts of nitrogen in the above unmixed materials rendered soluble by putrefaction were also determined by a method of which the following is the perfected form:

"Into narrow-necked flasks of about 500 cc. capacity were weighed duplicate portions of each of the materials under experiment, together with 0.12 gm. of tobacco ash, which had been slightly acidified with phosphoric acid and dried; 300 cc. of water from the city service pipes was added to each flask and the contents were boiled briskly for an hour. Before cooling, the necks of the flasks were filled with sterilized cotton plugs.

"To each flask was next added 0.05 gm. sodium carbonate, sufficient to neutralize any free acid and to give the contents an extremely slight alkaline reaction, and finally was introduced 1 cc. of a putrid extract from a mixture of rotting meat and manure.

"The flasks were placed in a water bath which was kept at a constant temperature of 100° F. during the day and allowed at night to sink to the temperature of the room, which did not vary much from 76° F.

"From time to time the flasks were gently shaken, and after 21 days their contents were filtered and the residues, without washing, were brought back into the flasks with 300 cc. of water and the same quantities of tobacco ash, sodium carbonate, and putrefying solution as before and let stand for 52 days longer.

"In the filtrates just mentioned were determined both the total nitrogen and that portion of it which was volatile when distilled with magnesium oxid. . . .

"To conclude the experiment, the contents of the flasks were again filtered, the residues were thoroughly washed, and the filtrates with the washings were examined as above described. The nitrogen of the residues was also determined. . . .

"In a considerable number of cases the quantity of nitrogen dissolved by putrefaction during 7 months does not agree with or bear any very definite relation to the quantity dissolved by pepsin solution.

"The most striking discrepancies are observed with ground bone, . . . and especially with the samples of hard raw bone, which it is evident are likely to be less finely ground than the steamed or soft bone, and, if pulverized to the same degree, are less easily penetrated and dissolved by the putrefactive agencies. . . .

"The nitrogen of cotton-seed meal, linseed meal, and castor pomace was quite readily dissolved during putrefaction, though not to the same extent as with pepsin solution.

"It is noticeable that the nitrogen of the two samples of undecorticated meal is much less soluble than that of clear decorticated meal under putrefaction as well as in pepsin solution.

"In the single samples of fish, blood, and ammonite there was substantial agreement between the results of the two methods. . . .

"Lastly, the two methods of determining nitrogen-solubility fairly agree in the case of three nitrogenous materials, known to be of inferior quality, as appears below:"

Comparative nitrogen-solubility in pepsin and under putrefaction.

	Nitrogen-solubility—	
	In pepsin solution.	Under putrefaction.
	Per cent.	*Per cent.*
Tankage	37.7	35.2–37.0
Ground animal matter	32.2	41.5–42.7
Ammonite A	41.8	37.1–47.6

In tests on mixed fertilizers there was "a practical conformity between the indications of the two methods, though in many cases the agreement is not close."

"While the pepsin method is more convenient and rapid, the putrefaction method might be regarded as a nearer approach to the 'natural' method by which organic nitrogenous matters are disintegrated in the soil and prepared for appropriation by plants. It is not certain, however, that putrefaction gives a better indication of the relative value of fertilizers as a nitrogen supply to plants than the pepsin method."

To determine "whether either treatment is the proper criterion of the availability of the nitrogen of fertilizers" 6 of the materials examined by both methods were selected for culture tests. For this purpose galvanized iron pots 6 in. in diameter and 9 in. deep were filled with 2,300 gm. of an artificial soil, very poor in nitrogen, consisting of coal ashes and peat moss (5 per cent) mixed with 4 gm. of Thomas slag and 1 gm. each of phosphatic guano and muriate of potash.

"Four pots were devoted to each of the 6 fertilizers. To the soil in 1 of these 4 pots was added 1 decigram of organic nitrogen, supplied by the fertilizer under experiment. The second pot received 2 decigrams, the third pot 4 decigrams, and the fourth pot 8 decigrams of organic nitrogen."

Water was carefully poured on the surface of each pot until the total weight was 5,800 gm. In every case 10 cc. of extract of garden soil was added, and a dwarf variety of corn was planted, 3 stalks of which were allowed to grow in each pot. The pots were watered from time to time with water from the city service pipes filtered through a Pasteur-Chamberland filter, the water content being brought to 40 per cent and not allowed to sink below 30 per cent. It was found that if the water content sank as low as 20 per cent the plant suffered.

The plants were "small and imperfectly developed, and produced no ears on account of the limited supply of nitrogen," but entirely healthy and thrifty in appearance. When they had finished growing the crop in each pot was harvested separately, weighed, and the percentage of nitrogen determined.

The following table shows the comparative availability of the nitrogen of the 6 fertilizers used—shown by pepsin digestion, putrefaction, gain in nitrogen in crop, and increase in crop, all expressed in per cent of availability of the nitrogen in the best fertilizer:

Comparison of peptic, putrefactive, and culture tests of availability of nitrogen in different fertilizers.

	A.	B.	C.	D.	E.	F.
Relative nitrogen-solubility by pepsin	53	32	36	59	100	79
Relative nitrogen-solubility by putrefaction	74	48	64	60	100	87
Relative crop-producing power	92	57	96	39	100	77
Relative gain of nitrogen	95	62	104	44	100	75

"The nitrogen of sample E shows throughout the greatest peptic and putrefactive solubility as well as greatest crop-producing capacity, and with one exception (C) has given the most nitrogen to the crops. Sample B has yielded the least soluble nitrogen to pepsin and under putrefaction, but D, in the culture test, is least effective as a fertilizer. Samples A, C, and E, which vary so widely in the peptic and putrefactive solubility of their nitrogen, manifest very little difference in their average crop-producing powers as measured by either the crop increase or gain of nitrogen by the crops.

"It is evident that the tedious vegetation cultures are the only true test of the availability of organic nitrogen, while the pepsin digestion may give useful indications but can not be depended on for decisive results.

"If opportunity offers it is purposed to continue investigations in these or similar directions."

Guide to the use of fertilizers in Algeria, F. DEBRAY (*Paris: A. Challamel, 1894, pp. 78.*)

How can the farmer conserve and increase his supply of nitrogen? J. KÖNIG (*Berlin: Paul Parey, third edition, pp. 184*). Revised in collaboration with E. Haselhoff.

The utilization of the nitrogen of stable manure and of green manures, J. KÜHN (*Deut. landw. Presse, 21 (1894), Nos. 33, 34, 49, 51*).

Organic and ammoniacal nitrogen—irrational treatment of human excrement, MAIZIÈRES (*L'Engrais, 9 (1894), No. 27, p. 637*).—An argument in favor of more general use of human excrement, treated with sulphuric acid and dried.

Sewage disposal and river pollution, R. F. GRANTHAM (*Trans. Surv. Inst., 25 (1893), Nos. 12 and 13; abs. in Jour. Roy. Agr. Soc., 1894, June, pp. 342–352*).

Fertilizers and farmyard manure, W. F. MASSEY (*Southern Planter, 1894, July, pp. 349, 350*).—A controversial article.

Should farmers mix fertilizers? J. GOERZ (*Country Gent., 1894, July 5*).—Argues against it.

Improvements in the manufacture of fertilizers, J. J. SELDNER and J. WATSON, jr. (*Jour. Soc. Chem. Ind., 13 (1894), No. 5, p. 533*).—According to this process, which is patented in England, refuse hair, leather, etc., (1) are treated with sulphuric acid and digested in a steam jacket under a pressure of 30 lbs. The acid is neutralized with alkalies and phosphates and the resulting product dried out. (2) These materials are mixed with dissolved bone or superphosphate and digested in the same way.

Simple methods for detecting adulteration in bone meal, sulphate of ammonia, and kainit (*Agl. Gaz. N. S. W., 5 (1894), No. 5, pp. 331-333*).—Simple tests, not requiring chemical skill, for impurities.

Fertilizer inspection and analysis in Connecticut (*Connecticut State Sta. Rpt. 1893, pp. 1–71*).—This is a reprint from parts I and II of the Annual Report of the station for 1893 (E. S. R., 5, pp. 777, 860).

Fertilizer analysis and valuation (*Massachusetts State Sta. Bul. 52, pp. 2–6, 8*).—A schedule of trade values for 1894 is given with tabulated analyses of 78 samples of fertilizing materials, including compound fertilizers, bone, and ashes.

FIELD CROPS.

Field experiments with corn, W. C. LATTA (*Indiana Sta. Bul. 50, pp. 43–53*).

Synopsis.—These experiments embrace tests of time of planting, length of period of growth for corn planted at different dates, thickness of planting, improvement by selection, depth of plowing, depth of cultivation, rotation, residual effects of stable manure, and effect of fertilizers. Taking in most cases the averages for a number of years the results favor planting not later than May 10, shorter period of growth for corn planted late, a distance of from $10\frac{3}{4}$ to $13\frac{3}{4}$ in. in the drill, plowing at least 8 in. deep, shallow culture, rotative cropping, a notable residual effect of stable manure on the tenth crop after manure was applied, and an increased crop yield not sufficient in the first year after the application of fertilizers to repay their cost.

In 1893 the yields were low, due to severe and protracted drought.

Time of planting (p. 45).—The dates of planting ranged from May 1 to May 30, and the experiment extended over 5 years.

Length of period of growth (p. 46).—Results for 1892 and 1893 with 3 varieties are reported. In 1893 corn planted June 14 to 16 matured in 105 days; that planted May 6 required 122 days.

Thickness of planting (pp. 46, 47).—With rows $3\frac{3}{8}$ ft. apart the average results for 8 years were as follows: Stalks $10\frac{3}{4}$ in. apart, 50.71 bu. per acre; $12\frac{1}{8}$ in. apart, 49.30; $13\frac{3}{4}$ in. apart, 50.08; $16\frac{1}{4}$ in. apart, 46.22; $19\frac{1}{2}$ in. apart, 43.38. In 1893, contrary to the results of previous years, every increase in distance was followed by an increased yield.

Improvement by selection (p. 47).—This experiment, requiring several years, was begun in 1893.

Depth of plowing (pp. 47, 48).—The yield of corn for 3 years on land plowed from 4 to 12 in. deep was as follows:

Yield of corn per acre from deep and shallow plowing.

Depth of plowing.	1891.	1892.	1893.	Average, 3 years.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*
4 to $4\frac{1}{2}$ in	49.3	52.9	16.1	39.48
6 in	49.1	58.9	13.6	40.54
8 in	[1] 49.8	[1] 60.0	[1] 17.1	42.28
10 in	[2] 49.6	[2] 59.7	[2] 17.0	41.76
12 in	[2] 46.7	[2] 61.4	[2] 17.5	42.01

[1] Average of 3 plats. [2] Average of 2 plats.

"The small variations in yield in 1891 are doubtless due to the fact that all the plats had been plowed 8 in. deep in previous years."

Depth of cultivation (pp. 48, 49).—On land plowed about 8 in. deep the average yields per acre for 6 years were as follows: Cultivated about 1 in. deep, 51.06 bu.; about 2 in. deep, 50.09; about 3 in. deep, 48.73. In 1893 deep culture gave slightly better results than shallow.

Rotation (pp. 49–51).—

"On one series of plats only grain crops are grown. . . . The crops of this series are corn, oats, and wheat. The same crops have been grown in rotation in connection with clover and timothy on an adjacent series. The crops on both series have been grown without any manure or fertilizers and fully harvested and removed in every instance. The yields of corn on the two series for 1893, and the average yields for the last 6 years, are as follows:"

Yield per acre from rotative and successive cropping.

	1893.	Average, 6 years.
	Bushels.	*Bushels.*
Crops grown in rotation	22.2	31.99
Grain crops only grown	15.1	27.46
Gain from rotation	7.1	4.53

The yields of another series of plats on which wheat and corn alternated, with and without fertilizers, are tabulated.

Residual effect of stable manure (pp. 49, 50).—On land which has been in corn continuously since 1879 fresh stable manure was applied in 1883 and 1884, the total quantity being about 50 tons per acre. Since 1884 no manure has been applied. The yields on the manured plats and on check plats not manured in 1883 and 1884 are given in the following table:

Yield of corn per acre from manure applied in 1883 and 1884.

Year.	Manured.	Unmanured.	Increase.	Year.	Manured.	Unmanured.	Increase.
	Bushels.	*Bushels.*	*Bushels.*		*Bushels.*	*Bushels.*	*Bushels.*
1883	56.9	47.5	9.4	1890	38.6	31.6	7.0
1884	53.5	39.1	14.4	1891	37.5	27.2	10.3
1885	63.7	42.2	21.5	1892	33.1	26.5	6.6
1886	45.6	26.4	19.2	1893	16.7	13.3	3.4
1887	7.0	5.5	1.5				
1888	60.4	52.1	8.3				
1889	51.2	38.1	13.1	Average, 11 years	42.20	31.78	10.42

Effect of fertilizers (pp. 51–53).—This experiment was begun in 1889. Winter rye occupies the land during winter and is plowed under in spring. Light and heavy applications of fertilizers gave about the same increase, but in most instances the use of fertilizers was not profitable.

Observations on the growth of maize continuously on the same land (*Connecticut State Sta. Rpt. 1893, pp. 286–300*).

Synopsis.—Yield in dry matter of plats differently fertilized; analyses of kernels, cobs, and stover grown with different manures and fertilizers; gain or loss of fertilizing ingredients in the soil by 4 years of manuring and cropping with corn; determination of the amounts of nitrogen in the experimental plats; and notes on the Dumas, Kjeldahl, and Jodlbauer-Kjeldahl methods of determining nitrogen. Thirteen and one half cords of hog manure per acre gave slightly larger crops than 10 cords of cow manure. The dry matter of the kernels grown on unfertilized land contained a smaller percentage of albuminoids, fat, and ash, but a larger proportion of fiber and nitrogen-free extract than the grain grown on highly fertilized soil.

A continuation of the work described in the Annual Report of the station for 1892 (E. S. R., 4, p. 906). In 1890, 1891, 1892, and 1893 plat A was fertilized with cow manure at the rate of 10 cords per acre, plat B with 13½ cords of hog manure per acre, plat C with 1,700 lbs. of chemical fertilizers per acre, and plat D was unfertilized since 1888 and 1889, in which years all the plats received an application of commercial fertilizers. The yields per acre of dry matter in 1893 on plats differently fertilized were as follows:

Yield per acre of dry matter in corn crop.

	Cow manure.	Hog manure.	Chemical fertilizers.	No fertilizer.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
Kernels	2,223.0	2,171.8	1,537.9	748.5
Cobs	428.7	406.3	308.5	149.0
Stover	2,625.3	2,441.4	2,011.8	1,379.6
Total	5,277.0	5,019.5	3,858.2	2,277.1

The relative yields of dry matter for 4 years, the yield of the plat fertilized with cow manure being taken as 100, were as follows:

Relative yields of dry matter in corn crop differently fertilized for 4 years.

	Cow manure.	Hog manure.	Chemical fertilizers.	No fertilizer.
1890	100	104.7	89.5	73.5
1891	100	92.9	82.0	65.9
1892	100	114.6	98.3	48.9
1893	100	95.1	73.2	43.1
Average	100	102.2	86.6	60.1

As the average of 4 years, hog manure gave results slightly better than cow manure, chemical fertilizers nearly seven eighths as much, and the unfertilized plat only three fifths as much as the plat manured with cow manure.

Taking the average composition of the crop for 4 years, the dry matter of the kernels grown on the unfertilized plat contained a smaller percentage of albuminoids, fat, and ash, but a higher percentage of fiber and nitrogen-free extract, than the grain grown with the aid of cow manure, a deficiency of fertilizing materials having affected the quality as well as the quantity of the crop.

The following table shows the difference in the amounts of nitrogen, phosphoric acid, and potash supplied in manures and removed in the crops, the plus sign indicating that the manures supplied more than the crops removed and the minus sign that the manures afforded less fertilizing material than the crops removed:

Enrichment or improvement of soil by 6 years' manuring and cropping of corn.

	Cow manure.			Hog manure.		
	Nitrogen.	Phosphoric acid.	Potash.	Nitrogen.	Phosphoric acid.	Potash.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
After 5 years' cropping	+494.5	+447.0	+440.4	+855.0	+1,766.4	+43.4
Applied in 1893	286.3	136.4	204.5	419.9	586.5	72.4
Taken off in crop of 1893	74.6	21.6	74.4	61.7	22.9	47.3
Excess (+) or deficiency (—) after 6 years' cropping	+706.2	+561.8	+570.5	+1,207.8	+2,330.0	+68.5
	Fertilizer chemicals.			**No fertilizer.**		
	Nitrogen.	Phosphoric acid.	Potash.	Nitrogen.	Phosphoric acid.	Potash.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
After 5 years' cropping	+184.1	+536.7	+95.9	—227.1	+82.5	—29.3
Applied in 1893	172.0	162.0	69.0	00.0	00.0	00.0
Taken off in crop of 1893	55.2	15.4	35.5	29.8	8.9	10.7
Excess (+) or deficiency (—) after 6 years' cropping	+300.9	+683.3	+129.4	—256.9	+73.6	—40.0

Analyses of samples of soil taken October 6, 1891, give the amount of nitrogen in the plats variously fertilized in the two preceding seasons:

Nitrogen per acre in plats differently fertilized.

	Cow manure.	Hog manure.	Chemical fertilizers.	No fertilizer.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
Surface soil, 8 in	3,620	3,726	3,458	2,939
Subsoil, 8 to 16 in	877	1,831	1,403	714
Subsoil, 16 to 24 in	480	808	394	285
Subsoil, 24 to 32 in	237	....	....	....

The Dumas, Kjeldahl, and Jodlbauer-Kjeldahl methods of determining nitrogen were compared, and the agreement of results was entirely satisfactory to the chemist.

Experiments on meadows made at the Pumpherston (Scotland) Experiment Station, A. P. AITKEN (*Trans. Highland and Agl. Soc. Scotland, 1894, pp. 385–409*).—Seed of a mixture of grasses and clover

was sown in 1887 on land which in that year and in the preceding year had not been fertilized. Beginning with 1888, fertilizers were annually applied to some of the plats in such quantities as to supply 36 lbs. per acre of phosphoric acid, potash, and nitrogen, either alone or in combination.

It was not until the fourth season that the full effect of the manures upon the botanical composition of the meadow was fully apparent, and the conclusions regarding the effect of manure are drawn largely from the average results of the fourth, fifth, and sixth years of the experiment. Perennial rye grass in these years constituted but a small proportion of the plants, and the action of special manures on this species was not notable. Orchard grass, more abundant than any other plant, required for vigorous growth a liberal supply of nitrogen, potash, and phosphoric acid, its most imperative need being for phosphoric acid, especially in the form of soluble phosphate. Apparently combined sulphuric acid was favorable to its growth. Timothy was most responsive to nitrogen and then to potash, the want of phosphoric acid being less felt than that of the other two constituents. Dog's-tail grass flourished best on the poorest plats, and it grew relatively well on those well supplied with insoluble phosphates. Its shallow root system probably enabled it to utilize these to a greater extent than more deeply rooted grasses were able to do. In wet seasons it was relatively abundant, but the proportion of dog's-tail grass to orchard grass decreased very largely in hot and dry summers. Rough-stalked meadow grass and Kentucky blue grass did not seem to feel the want of nitrogen so much as most grasses; the latter developed a deeper root system than the former. The fescue grasses showed no special preference for any one fertilizing constituent. With their deep root system they were less dependent than most grasses on top dressings and were able to endure in a noteworthy manner the long continued drought of 1893.

After a few years the only clover growing on the plats was white clover. This clover was at its best when potash was applied, and failed when potash was wanting. When insoluble nitrogenous manures were applied white clover was thrifty, but when soluble forms of nitrogen were used the plats were deficient in clover. This plant showed no special preference for any one form of phosphoric acid except Thomas slag, the favorable effect of which was probably due to its content of lime.

Experiments with oats, W. C. LATTA (*Indiana Sta. Bul. 50, pp. 53–55*).—Of 7 varieties grown from 1 to 7 years, White Bonanza gave the largest average yield.

In an experiment on thickness of seeding 4, 5, 6, 7, 8, 9, 10, 11, and 12 pecks of seed per acre were used; 8 pecks gave the highest average yield for 8 years, but 10 pecks is recommended when oats are sown among cornstalks.

The economical manuring of the turnip crop, A. P. AITKEN (*Trans. Highland and Agl. Soc. Scotland, 1894, pp. 435-447*).—This experiment was conducted on a number of Scottish farms in 1893. Equal values of the different combinations of fertilizers were applied to each plat. Superphosphate was more effective than Thomas slag, and the latter gave better results than fine-ground bone. A combination of superphosphate and slag was more effective than any single phosphatic fertilizer. No advantage resulted from the use of more than 1 cwt. of nitrate of soda per acre. In 1893, in which the first two months of the growing season were very dry and the remainder of the season very wet, sulphate of ammonia proved superior to nitrate of soda. The author recommends for turnips a mixture of these two nitrogenous fertilizers in combination with a mixed phosphatic fertilizer.

The ripening of wheat, N. PASSERINI (*Staz. Sper. Agr. Ital., 26 (1894), No. 2, pp. 138-150*).—The author conducted this investigation in 1893 on two varieties of wheat. Daily determinations of the weight of 100 grains, and of the organic matter, water, and ash contained in the same, were made from June 9 to July 8, inclusive.

The weight of 100 grains increased quite regularly until June 21-22, at which time the grains had assumed the color denoting ripeness. After this time there was a gradual diminution in the weight of the seed. The dry matter in the grain reached its maximum weight 2 to 4 days after the seed reached the maximum weight, then it decreased slightly.

The composition of the grain at different dates showed that a notable decrease in the percentage of water followed close upon a rise of several degrees in the temperature of the air.

With one variety the best date for cutting was found to be June 19-23, at which time the heads showed no trace of green color, while the seed were still turgid and moist. This yield was decreased by 7 per cent when the harvesting was done June 30 to July 7. With the other variety the loss from harvesting late was 14 per cent. The conclusion drawn is that wheat should be harvested when the ears are yellow, but before the straw has lost the green color.

Rational selection of wheat for seed, H. L. BOLLEY (*North Dakota Sta. Bul. 13, pp. 4-26, figs. 8*).—A general discussion of wheat-growing in North Dakota and of selection of seed wheat. The percentage of germination and the yield of wheat from normal seed and from seed frosted, winter bleached, immature, and heated in the bin are tabulated. The yield from normal seed was much larger than that from seed injured in any way. For example, in one instance the crop from seed frosted before maturity, was to the crop from normal seed, as 113:194.9. Normal seed and injured seed gave practically the same weights for the same volume of grain. Smutted wheat, however, weighed slightly less for a given volume than sound wheat. The author recommends the selection, by means of a fanning mill, of large grains for seed.

Field experiments at Grignon, France, from 1890 to 1893, J. DUPONT (*Ann. Agron., 20 (1894), No. 3, pp. 137–156; No. 5, pp. 229–247*).—The very favorable residual effect of stable manure is emphasized by the results of these experiments. Neither direct applications of stable manure nor of nitrate of soda gave yields of wheat equal to those secured where stable manure had been applied to preceding crops.

Soluble phosphates were especially favorable to the growth of wheat on exhausted soil. However, they exercised no such advantageous influence on oats, probably, the author suggests, because oats with a stronger feeding power were able to utilize difficultly soluble phosphates in the soil and could thus dispense with applications of soluble phosphates which on exhausted soil were necessary for wheat.

Soluble phosphates were not specially beneficial to clover, the growth of which was chiefly dependent on the amount of organic matter accumulated in the soil as the result of previous applications of stable manure.

In the rotation adopted at the station clover was sown with oats, and succeeded best when sown with the early varieties. Experiments in manuring hemp were conducted, but this crop did not succeed.

Even in the fourth year, after the sod of a temporary meadow was plowed under, there was apparently an injurious effect on the wheat crop, but none on the oat crop. A drought occurring in April and May injured the crop of oats more than the crop of wheat, due doubtless to the fact that the roots of wheat penetrated the soil to a depth of 70 in., while the roots of oats reached to only 44 in.

The lodging of oats was less injurious than the lodging of wheat occurring at the same time.

Pollination of cereals, A. N. M'ALPINE (*Trans. Highland and Agl. Soc. Scotland, 1894, pp. 133–170, pls. 13*).—This is an illustrated article on the improvement of cereals by selection and crossing. Rimpau's, Carter's, Maund's, and Raynbird's results are briefly noticed, and the methods and results of the work of Messrs. Garton in crossing varieties of wheat, barley, and oats are detailed at length.

Investigations concerning the root growth of agricultural plants in its physiological and cultural relations, II, C. KRAUS (*Forsch. Geb. agr. Phys., 27 (1894), No. 1 and 2, pp. 55-103*).

Pastel, or woad (Isatis tinctoria) as a forage plant, E. SCHRIBAUX (*Prog. Agr. et Vit., 11 (1894), No. 23, pp. 601–604*).—A record of pot experiments made in 1893–'94 in growing pastel on different soils, and a popular discussion of the plant.

Experiments with varieties of potatoes at Sobieszyn, Russia, in 1893, A. SEMPOTOWSKI (*Deut. landw. Presse, 21 (1894), No. 54, pp. 533, 534*).—Yield and starch content of 11 varieties.

Second-crop potatoes, W. F. MASSEY (*Rural New Yorker, 1894, July 14, p. 440*).

The future of the American sugar industry, W. C. FITZSIMMONS (*Irrigation Age, 6 (1894), No 6, pp. 264–256, map 1*).—A popular article on sugar-beet raising in the United States, with a map showing the profitable regions.

Experiments in growing tobacco with different fertilizers in 1892 and 1893, S. W. JOHNSON (*Connecticut State Sta. Rpt. 1893, pp. 112–144*).—This is a reprint from part II of the Annual Report of the station for 1893 (E. S. R., 5, pp. 863, 865).

The wood vetch (Vicia dumentorum), (*Deut. landw. Presse, 21 (1894), No. 50, p. 501*).—Brief notes on its growth, with illustration, and on its chemical composition.

Experiments with varieties of winter wheat in Russian Poland, A. SEMPOTOWSKI (*Deut. landw. Presse, 21 (1894), No. 47, p. 467*).

HORTICULTURE.

Tomatoes, J. F. C. DUPRE (*South Carolina Sta. Bul. 16, pp. 11*).—Descriptive notes on 45 varieties tested, with brief mention of the soil and methods of culture employed. The plants were set 3½ to 4 ft. apart in 4-ft. rows, in a sandy loam well mixed with compost. Early Ruby, Chemin, and Hathaway Excelsior are recommended as early varieties, and for a general crop Matchless, Mitchell New, Stone, Red Cross, Dwarf Champion, Golden Sunrise, and Acme.

The boll, or corn, worm (*Heliothis armigera*) destroyed one fourth of the early crop. Burying the infected fruit is advised for this and the black rot.

Tabulated data are given for 30 varities.

Investigations of California olives and olive oils, A. P. HAYNE (*California Sta. Bul. 104, pp. 16, fig. 1*).

Synopsis.—Researches into the olive and olive-oil industry in California, chiefly the latter phase being examined. The maturity and the time for the picking of olives were looked into, and various machines for obtaining the oil were tested. The methods employed are detailed, and tables given showing the results of the analyses of 29 varieties represented by many samples.

Results of preliminary investigations as to the best varieties of olives to be grown in California for pickling and oil. Sixty-seven samples of olives were received from 10 different regions, 10 of them being in sufficient quantity for making oil.

Polymorpha, averaging 13 olives to 100 gm. and 83 per cent of flesh, is recommended as a good variety to pickle.

It is advised that the olives for oil be gathered when they are red, without waiting for them to become black, as is usually the custom, for the oil from the black, overripe fruit has a "greasy" or "lardy" taste, is more apt to "cloud" and deposit a sediment, and solidifies at 45°, while the oil of the others remains clear and fluid down to 35°. Oil from olives grown on gravelly, light, well-drained soils, as on hillsides, proved superior to that of olives from rich bottom lands.

It was found that olives should be made use of soon after being gathered, as they undoubtedly deteriorate in storage, and if olives are caught by frost they should be picked and crushed for oil within 3 days, as otherwise the decomposing tissue greatly injures the flavor of the oil.

For crushing the olives, preparatory to pressing out the oil, two machines were imported from Spain, a "pitter" and a "crusher," but they proved unsatisfactory and a small fruit-juice press was used, consisting of an endless, tapering screw inclosed in a conical sleeve. In

pressing the mass of pulp, pits, skins, oil, and water was divided into 25-lb. packages and wrapped in sail cloth, which was found cheaper and preferable to the grass mats used in Europe. The mingled oil and water from the pressing were separated by an apparatus devised at the station, being allowed to flow into a tank about 4 ft. high and 2 ft. in diameter. The inlet was near the bottom, and just below it a series of jets of water washed impurities out of the oil, which rose to the top and was drawn off by a stopcock, the height of the water being regulated by another stopcock and an escape pipe. The oil was clarified by filtration, experiments being made with cotton batting, glass wool, asbestos, and filter paper. Only the last was found to be adapted, and frequently two filtrations were necessary.

The same variety was found to vary in different localities in regard to the proportion of flesh and percentage of oil, and tables are given showing the analyses. Rubra varied the most in amount of oil, there being over 20 per cent difference between the maximum and minimum found.

Mission, Manzanillo, and Nevadillo Blanco are recommended as oil producers, and Redding Picholine is considered unworthy of the place it has in the plantations, as its fruit is small and "greasy" and possesses large pits.

The investigations are to be continued another year.

Vegetables and fruits in 1893, F. H. BURNETTE, G. WATSON, and W. C. STUBBS (*Louisiana Stas. Bul. 27 (2d ser.), pp. 876–956*).—Results of the year at the Baton Rouge, Calhoun, and Audubon Park Stations. Notes are given on the yields and cultivation, and particularly of the fertilizing where done. There were tested several varieties each of asparagus, bush beans, pole beans, beets, cabbage, celery, corn, cucumbers, endive, eggplants, leek, lettuce, mustard, muskmelons, watermelons, onions, parsley, peas, peppers, Irish potatoes, radishes, squashes, tomatoes, turnips, apples, figs, grapes, oranges, peaches, peas, persimmons, plums, quinces, strawberries, blackberries, dewberries, goumi, gooseberries, raspberries, and wineberries.

Fruits and vegetables in 1892, G. C. BUTZ (*Pennsylvania Sta. Rpt. 1892, pp. 107–129, figs. 9.*)—*Orchard fruits* (pp. 107–115).—Descriptive and illustrated notes on 7 recent varieties of apples and 3 of pears, with brief notes on the productiveness of 23 other varieties of pears, and mention of an unsatisfactory plum crop, in which the fruit dropped from some undetermined cause.

Small fruits (pp. 116–121).—Notes and tabulated data for 23 varieties of strawberries, Greenville, Crescent, Shuster Gem, and Van Deman giving the highest yields; and for 13 varieties of blackberries, Eldorado, Early Cluster, and Early Harvest producing the largest crops. No raspberries were fruited, but brief notes are given on 4 varieties of gooseberries and 2 of grapes.

Vegetables (pp. 122–129).—Notes and tabulated data for 4 varieties of asparagus, 18 of beans, 13 of sweet corn, 14 of peas, and 23 of tomatoes. The "Chinese potato" (*Dioscorea batatas*) is being tested, and has produced a fair crop of tubers.

Electroculture (*La Culture Électrique*), C. CRÉPEAUX (*Paris: J. Micheles*).—Various methods of application of electricity during the germination and growth of plants.

Manuring asparagus, E. LIERKE (*Prak. Ratgeber im Obst- und Gartenbau, 1893, Nos. 39, 40, 41; abs. in Centbl. agr. Chem., 23, No. 6, p. 380*).—Analyses of asparagus, and calculations as to the proper fertilizers to apply.

Garden manuring in connection with tomatoes, L. GRANDEAU (*Jour. Agr. Prat., 58 (1894), No. 26, pp. 917, 918*).—Notes on the author's experiments on the soil of his own garden, chiefly with liquid manures.

The manuring of fruit trees (*Wiener ill. Gart. Ztg., 19 (1894), No. 5, pp. 189–196*).—General remarks on the principles and practice, and experiments with various proportions of sodium nitrate, kainit, and Thomas slag, a mixture containing a little more of the latter two than of the first, giving best results.

Treatment of overladen fruit trees (*Wiener ill. Gart. Ztg., 19 (1894), No. 1, pp. 20–22*).—Remarks on the proper pruning, cultivation, and fertilizing of several orchard fruits.

Pacific coast seedling fruits, C. H. SHINN (*Gard. and Forest, 7 (1894), pp. 242, 243*).—A brief article on fruits that are being originated on the Pacific coast, and many of which seem commendable.

The biology and cultivation of the fig (*Wiener ill. Gart. Ztg., 19 (1894), No. 3, pp. 93–97*).—A general and popular article on the origin, culture, fruiting, and varieties of figs.

Flowering and fertilization of the native plum, E. S. GOFF (*Gard. and Forest, 7 (1894), pp. 262, 263*).—Results of experiment with 22 varieties. The frequent sterility was found to be due to imperfect pistils. The percentage varies, and in Wisconsin the abortive pistils are thought to be produced by the severe climate.

Devices for protecting strawberries from soil injury (*Deut. landw. Presse, 21 (1894), p. 487*).—Notes on placing various shielding disks of metal, wood, and pasteboard beneath the ripening fruit.

Green manuring for grapes, E. CHUARD (*Chron. Agr. Cant. Vaud., 7 (1894), No. 11, pp. 292–294*).—A short popular article on the subject, giving the requirements of the vine and the advisability of supplementing other fertilizers with green manures, clover and lupine being recommended.

Influence of different systems of pruning on the quantity and quality of grapes and on the composition of must, A. SANSONE (*Staz. Sper. Agr. Ital., 26 (1894), No. 4, pp. 389–399*).

Bulbous plants in North Carolina, W. F. MASSEY (*Gard. and Forest, 7 (1894), p. 278*).

Food requirements of the chrysanthemum, J. J. WILLIS (*Gard. Chron., 25 (1894), No. 391, p. 778*).—Average of analyses by A. B. Griffiths is given and used as a basis for calculating fertilizer requirements.

FORESTRY.

The introduction of hardy, useful, and ornamental trees, J. B. WEBSTER (*Trans. Highland and Agl. Soc. Scotland, 1894, pp. 319–332*).—The author gives the results of his extended observations on the suitability of various conifers for forest and nursery planting, together with suggestions as to most favorable soils and methods of handling, as well as notes of historical and botanical interest on many of the species. He reports favorably on 32 species as follows: *Abies balsamea, A. nobilis, A. webbiana, A. nordmanniana, A. cephalonica, A. lasiocarpa, A. pinsapo, A. sibirica, Pseudotsuga douglasii, Tsuga mertensiana, Picea orientalis, P. nigra, Pinus insignis, P. ponderosa, P. pinaster, P. excelsa, P. parviflora, Sequoia sempervirens, S. gigantea, Cupressus macrocarpa, C. lawsoniana, C. nootkatensis, C. thyoides, Thuya gigantea, Cryptomeria japon-*

ica, Cedrus atlantica, Juniperus drupacea, J. chinensis, Cephalotaxus drupacea, C. fortunei, and C. pedunculata.

The effect of clearing away the dead wood in a forest, F. BAUER (*Forstw. Centbl., 16 (1894), No. 6, pp. 277–294*).

The effect of inundation on the forests of Bohemia, F. BAUER (*Forstw. Centbl., 16 (1894), No. 6, pp. 294–299*).

Effect of sun and frost cracks on the oak, R. HARTIG (*Forst. naturw. Ztschr., 3 (1894), No. 6, pp. 255–260*).—A general discussion of their origin, and effect on the timber.

The tallow wood (Eucalyptus microcorys), J. H. MAIDEN (*Agr. Gaz. N. S. W., 5 (1894), No. 5, pp. 289–297, fig. 1*).—Notes on its oil and gum, and a discussion of its timber value and of its distribution in Australia.

Two new willow hybrids, E. F. LINTON (*Jour. of Botany, British, 32 (1894), p. 201*).—Descriptive notes on a hybrid between *Salix caprea* and *S. myrsinites*, and on *Salix cernua*, a hybrid or new species.

WEEDS.

The Russian thistle, L. H. DEWEY (*U. S. Dept. Agr., Division of Botany, Bul. 15, pp. 26, pls. 3, maps 2*).—This bulletin gives the history of the Russian thistle (*Salsola kali tragus*) as a weed in the United States, with an account of the means available for its eradication, and is supplementary to Farmers' Bulletin 10 by the same division (E. S. R., 4, p. 669). Popular and technical descriptions are given of this weed, together with notes on its origin and history. The plant was introduced into this country in Bonhomme County, South Dakota, from Russia in 1873 or 1874. Since that time it has spread over 35,000 square miles, and is very troublesome over 25,000, causing serious losses to the farmer. It is distributed by the plants being blown about by the wind, through uncleaned seeds, and by the railroads.

The plant is an annual, the seed short lived, and by concerted action in preventing any from seeding for several years it may be eradicated. Clean cultivation of crops and careful attention to the waste places are the precautions to be observed. Building fences and planting trees are recommended as means for the prevention of its wide distribution by rolling.

The text of the weed laws of North and South Dakota is given. The maps of distribution show that it is already found in 7 States, being most abundant in North and South Dakota, Nebraska, Iowa, Minnesota, Wisconsin, and Colorado, in the order named.

Weeds and weeding, A. N. M'ALPINE and R. P. WRIGHT (*Trans. Highland and Agl. Soc. Scotland, 1894, pp. 1–69*).—The authors give in popular terms much valuable information on weeds and the means for destroying them. Various classifications are given, based on duration, habits of growth, and methods of multiplication. Directions are given for the destruction of weeds in general, together with specific means to be adopted against certain of the more troublesome species. Detailed

reports are given on about 60 of the more common weeds, among which are many usually found in lists of our worst weeds.

Noxious weeds, E. S. GOFF (*Wisconsin Sta. Bul. 39, pp. 38, figs. 19*).—Popular illustrated descriptive notes, together with general and specific hints for their suppression, are given by the author on the most troublesome weeds of his State, as follows: Canada thistle (*Cnicus arvensis*), burdock (*Arctium lappa*), oxeye daisy (*Chrysanthemum leucanthemum*), snapdragon or toad flax (*Linaria vulgaris*), cocklebur (*Xanthium strumarium*), sow thistle (*Sonchus arvensis*), wild mustard (*Brassica sinapistrum*), sour dock (*Rumex crispus*), wild parsnip (*Pastinaca sativa*), sweet clover (*Melilotus alba*), and the Russian thistle (*Salsoli kali tragus*).

The acts of the State legislature relating to the destruction of noxious weeds are also quoted.

False star thistle (Kentrophyllum lanatum), J. H. MAIDEN (*Agl. Gaz. N. S. W., 5 (1894), No. 5, pp. 298–300, fig. 1*).—Description and methods of exterminating this Australian weed.

DISEASES OF PLANTS.

Cotton-boll rot, J. M. STEDMAN (*Alabama Sta. Bul. 55, pp. 12, pl. 1*).

Synopsis.—The author describes a new disease of cotton due to a species of bacillus which is figured and described. It is accompanied by several saprophytic fungi, and two species of beetles. The attack begins within the bolls, and is only manifest after the lint and seed have decayed. Burning all diseased bolls is the treatment advised.

In 1893 the author had his attention called to what proved to be a new bacterial disease of cotton bolls. Two species of beetles, or their larvæ, and several saprophytic fungi were found in the diseased bolls which were never seen in sound ones. The author was led to make pure cultures of the bacteria always found in the diseased bolls, and was enabled by inoculations to cause the disease. He considers it a new species, to which he gives the name *Bacillus gossypina*, characterized as follows:

"Short, straight bacilli, truncate with slightly rounded corners, 1.5μ long and 0.75μ broad; usually solitary, sometimes in pairs, and occasionally in chains of from 3 to 4. Stains readily with the usual anilin colors.

"An aërobic, nonliquefying (slight liquefaction in old gelatin cultures), motile bacillus. Forms spores. Grows at the room temperature in the usual culture media, but more rapidly at 25° to 35° C. In gelatin tube cultures the growth in 3 days gives a milky appearance, which spreads from the line of puncture of the inoculating needle, until in 5 days the entire gelatin becomes milky and assumes a slight greenish color. In agar-agar the growth on the surface appears as a smooth, semi-transparent, milky layer, while the development along the line of puncture of the inoculating needle through the agar-agar takes place as a cloudy, more or less even growth, gradually becoming thinner at the periphery.

"Inoculated into healthy cotton bolls, a disease resulting in a rotting or decaying of the seed and lint is produced in from 1 to 2 weeks, which soon involves the carpels, and thus destroys the entire cotton boll."

The disease is easily distinguished from anthracnose (*Colletotrichum gossipii*) by the latter making its appearance as small reddish-brown spots, which enlarge and become dark, gray, or pink, as the case may

be, and finally consist of a pink center surrounded by dark bands. This new disease originates within the boll and does not make itself manifest until the contents are involved and decayed, when the carpels may show some signs of decay.

So far as observed this new disease is mostly confined to the middle and top crop and usually manifests itself about the first of August. It spreads rather evenly over the field, preferring high ground to river bottoms and sometimes occasions a loss of 35 per cent of the crop.

The author's summary is as follows:

"The cotton-boll rot disease is caused by a bacterium (*Bacillus gossypina*), which works within the boll, causing its contents (seed and lint) to decay. And since the bacteria are inside the tissues it would be useless to spray the plant with any chemicals at present known, since we would kill the plant before the diseased region could be reached.

"The disease is multiplied in, and carried from, one crop of cotton to another, and also to unaffected areas, by means of the diseased tissues, with probably the help of the wind and insects.

"The bacteria may possibly enter the cotton plant from the soil through the roots, although it is possible they may enter through the epidermis of the boll; but more probably they are already in the seed leaves of the seed or enter the bolls from the flower.

"All diseased cotton bolls should be picked off and burned just as soon as discovered, or at least while the lint is being gathered, and the field gone over again immediately after the last picking of the lint.

"Cotton seed coming from a gin known to have ginned cotton from an affected district should not be planted in unaffected districts."

Puccinia phlei-pratense, a new species of grass rust, J. ERICKSSON and E. HENNING (*Ztschr. Pflanzenkrank., 4 (1894), No. 3, pp. 140–142*).—The authors describe a new rust found on timothy characterized as follows: Æcidium unknown, probably wanting; uredosori ½ mm. long, confluent on leaf sheath and halm, often forming masses 10 mm. long, yellowish brown. Spores oblong-pyriform, spinescent, dirty yellow 18 to 27 by 15 to 19 μ. The mycelium is probably perennial in the tissues of the host, since freshly formed pustules have been noticed as early as the beginning of May. The puccinia pustules on leaf sheath and halm 2 to 5 mm. long, or sometimes longer, confluent, narrow, dark brown to black; epidermis sometimes but slightly ruptured; spores spindle or club-shaped, sometimes constricted in the middle, chestnut brown, rounded or pointed, the points when present very thick; 38 to 52 by 14 to 16 μ. The puccinia stage is occasionally not to be found in the vicinity of Stockholm.

The authors report the finding of uredo pustules as late as December 28 and as early as March 27, showing the mycelium must be perennial. The puccinia sori appear from August 11 to November 30, and germinating teleutospores are found between April 4 and July 13. Inoculation experiments on barberry, timothy, rye, wheat, oats, barley, and blue grass gave negative results except in the case of timothy and one out of eight on oats.

In 1890 neither puccinia nor uredo phase was to be found about Stockholm, while in 1891 and succeeding years both were very abundant.

Ustilago tritici folicola, P. HENNINGS (*Ztschr. Pflanzenkrank., 4 (1894), No. 3, p. 139*).—The author describes a new form of *Ustilago tritici* collected by Prof. Schweinfurth on *Triticum vulgare*. The heads are distorted in a characteristic manner by the fungus, [illegible] leaves and their sheaths are conspicuously marked. On both surfaces of the leaves the spore masses are seen in long parallel rows, causing the leaves to split something after the manner of *Ustilago longissima*. The spores are globular or oblong, often irregularly angular, yellow to olive brown, 4.5 to 7 μ long, 4.5 to 6 μ in diameter, with a very smooth or slightly punctate epispore. The specimens were collected March 20, 1892, at Assioot, Upper Egypt.

Botrytis cinerea, Cladosporium herbarum, and Sphærotheca pannosa in Holland during 1892–'93, J. RITZEMA-BOS (*Ztschr. Pflanzenkrank., 4 (1894), No. 3, pp. 144–147*).

A disease of the vine caused by Botrytis cinerea, L. RAVAZ (*Compt. Rend., 118 (1894), No. 23, pp. 1289, 1290*).—Manifested by irregular spots on the leaves, and for some time not determined.

Development of fungi, L. H. PAMMEL (*Gard. and Forest, 7 (1894), pp. 248, 249*).

Result of recent investigations on the development of rust fungi, E. FISCHER (*Bot. Centbl., 59 (1894), No. 1 and 2, pp. 1–4*).

Culture experiments with Puccinia coronata, P. coronifera, P. trailii, P. digraphidis, P. moliniæ, and P. festucæ, H. KLEBAHM (*Ztschr. Pflanzenkrank., 4 (1894), No. 3, pp. 129–139*).

Entyloma lephroideum, a parasitic species of Ustilagineæ of the sugar beet, L. TRABUT (*Compt. Rend., 118 (1894), No. 23, pp. 1288, 1289*).

Smuts of wheat, oats, and barley, L. FOSTER (*Montana Sta. Bul. 2, pp 19–32*).—Information is given regarding the smuts of grain, most of which is compiled from Kansas Bulletin 15 (E. S. R., 2, p. 638) and Indiana Bulletin 35 (E. S. R., 2, p. 637).

Hormodendron hordei, a disease of barley, K. BRUHNE (*Beiträge Physiol. u. Morph. niederen Organismen, 1894, No. 4; abs. in Bot. Centbl., 58 (1894), No. 13, pp. 427–431*.

Olipitrichum, a new genus of mucedinous fungi, G. F. ATKINSON (*Bot. Gaz., 19 (1894), pp. 244, 245*).

Bacterial gummosis of grapes, PRILLIEUX and DELACROIX (*Compt. Rend., 118 (1894), No. 25, pp. 1430–1432*).

Two parasites, Alternaria brassicæ nigrescens and Tetranychus telarius, of the melon (*Riv. pat. veg., 2 (1893), pp. 227–240; abs. in Bot. Centbl., 59 (1894), No. 1 and 2, pp. 47, 48*).

Clubroot of turnips (*Jour. Roy. Agr. Soc., ser. 3, 5 (1894), No. 2, pp. 318–321*).—Due to lack of lime in soil.

Some investigations concerning oat and clover nematodes, J. L. JENSEN (*Abs. in Ztschr. Pflanzenkrank., 4 (1894), No. 3, pp. 182–184*).

On the destruction of cuttings and grafts, V. MAYET (*Rev. Vit., 1 (1894), No. 25, pp. 601–604*).—Notes on the insects and fungi attacking young shoots.

The treatment of chlorosis, G. GOUIRAND (*Rev. Vit., 1 (1894), No. 25, pp. 605–608*).

Investigations on the increase of yield by the application of large quantities of bisulphide of carbon to the soil in combating nematodes, A. GIRARD (*Compt. Rend., 118 (1894), p. 1078; abs. in Chem. Ztg., 18 (1894), No. 50, Repert., p. 158*).

The germicidal properties of tannic acid (*Centbl. Bakt. u. Par., 15 (1894), No. 23, pp. 891–894*).

The history and physiology of the copper question, C. MÜLLER (*Ztschr. Pflanzenkrank., 4 (1894), No. 3, pp. 142–144*).—A historical résumé.

Literature of fungus diseases, W. C. STURGIS (*Connecticut State Sta. Rpt. 1893, pp. 253–285*).—Reprint from Bulletin 118 of the station (E. S. R., 5, p. 1078).

Report of the mycologist, W. C. STURGIS (*Connecticut State Sta. Rpt. 1893, pp. 72–111*).—This is a reprint from part II of the Annual Report of the station for 1893 (E. S. R., 5, pp. 866, 877).

ENTOMOLOGY.

The pear midge, J. B. SMITH (*New Jersey Sta. Bul. 99, pp. 14, figs. 4*).

Synopsis.—Illustrated description of the pear midge, with accounts of its life history, distribution, and ravages in the United States. Lawrence pears suffer most, but other varieties are attacked. Top-dressing with kainit killed the pupæ while wintering in the ground.

The pear midge (*Diplosis pyrivora*) has been known and studied in Europe for half a century, but did not occur in the United States until introduced from France to Connecticut in imported pear stocks in 1877. The pest rapidly increased, and by 1893 had so spread as to be also abundant and destructive in southern New York and New Jersey.

The adult is a grayish, long-legged fly resembling a mosquito, with its wings expanding less than one fifth inch. It appears for a week or 10 days just before the pear blossoms open, and, piercing the corolla with its ovipositor, lays from 10 to 30 eggs on the stamens. These hatch in 3 or 4 days, and the larvæ pass at once into the core of the embryo pear, before the opening flower has exposed them to the sun. The larvæ become mature in early June and drop from the dwarfed, deformed pears to the ground, into which they burrow an inch or two, in the course of the summer spinning oval cocoons in which they pass the winter, emerging in the spring.

The seeds of the young pears are destroyed and the fruits grow slowly, acquiring a peculiar knobby appearance, and decay and drop from the trees in early summer. The Lawrence is the variety attacked in preference, followed by the Bartlett and other varieties in the order of the lateness of blossoming. In one orchard examined not a single Lawrence pear escaped, and over 50 per cent of the Bartletts were destroyed.

As it is obviously impossible to prevent the midges from laying their eggs in the blossoms or to destroy the larvæ while in the young pears, experiments were made of top-dressing the soil during the summer with various chemicals in the hope of killing the larvæ and pupæ. Muriate of potash, nitrate of soda, and kainit were applied with gratifying results, the former two killing a majority of the insects, while after treatment with the last not a single larva or pupa remained alive.

The following recommendations are made: A few Lawrence trees should be planted as a partial protection for the other varieties, and where possible the infested pears should be picked off and destroyed. If the attack is general the soil should be cultivated and rolled not later than the last week in May, and about the middle of June 1,000 lbs. of kainit to the acre should be applied over the full extent of the ground covered by the branches. In August crimson clover should be sown to use up the surplus potash, and the crop turned under deeply early the next spring.

Report on an investigation of bee diseases, R. HELMS (*Agl. Gaz. N. S. W., 5 (1894), pt. 4, pp. 256–266*).—A report on an investigation of bee paralysis and depilating disease. The symptoms of the diseases are described and experiments for prevention and cure detailed. Disinfecting the stands and hives by heat is advised. In the case of bee paralysis the bees are purged by means of mixing tincture of podophyllum with the honey fed them (1 fluid oz. to 6 lbs. of food). The hives are then closed for several hours, after which the bees are excited by spraying with diluted oil of cinnamon and driven from the hives into the open air. Every third or fourth day thereafter spraying is to be done with a one half per cent solution of carbolic acid. The depilating disease is considered due to *Bacillus gaytoni*. No remedy is suggested. Both diseases are probably contagious.

Beeswax moths, A. S. OLLIFF (*Agl. Gaz. N. S. W., 5 (1894), pt. 4, pp. 253–255, pl. 1*).—Descriptions are given of the larvæ of *Galleria mellonella* and *Achræa grisella*, feeding on honeycomb and wax débris in the bottom of hives. Cleanliness is advised, taking out the frames and jarring the larvæ from them, and fumigating badly infested hives with sulphur or burning them.

Vegetal parasitism among insects, F. M. WEBSTER (*pp. 19, pls. 3, figs. 2; reprint from Jour. Columbus Hort. Soc., 1894, Apr.*).—Original and compiled information concerning entomogenous fungi, chiefly the *Cordyceps* group, and the *Entomophthoreæ*. Especial mention is made of *Cordyceps melolonthæ* on white grubs (*Lachnosterna* spp.), *Isaria* spp. on *Hadena devastatrix* and *Nephelodes violans*, *Entomophthora sphærosperma* on *Phytonomus punctatus* and *Pieris rapæ*, an outdoor attack of *Empusa muscæ* on *Musca domestica* and *Oscinis* sp., *Empusa pachyrrhinæ* on *Pachyrrhina* sp., *E. aulicæ* on *Spilosoma virginica*, *E. jassi* on *Diedrocephalus mollipes*, and *Sporotrichum globuliferum* on the chinch bug (*Blissus leucopterus*). A classified list of 7 genera and 91 species of fungi is given, with the insect hosts, from all parts of the world.

Parasitic mimicry, A. GIRARD (*Ann. Soc. Ent. France, 1894, I, pp. 121–128*).—Certain insect hosts, infested by parasites, finally assume forms which by their mimicry of other objects protect the parasites during the pupa state. The larva of *Xylophasia rurea* when attacked by *Rhogas nigricornis* shortly quits the leaves upon which it feeds and attaches itself to trees near the ground or on the ground itself, where

it shrivels and looks like a small snail. The larvæ of some species of *Arctia* on being attacked by *Rhogas geniculator* fix themselves to stems of grass and look like fungus-infested caterpillars, which are not eaten by birds. *Zygæna filipendulæ* attacked by *Rhogas bicolor* acts in like manner. The protection lies in that the larvæ of *Zygæna* assume this same position when infested by fungi. The larva of a species of *Dactylopius*, when parasitized by *Leptomastix dactylopii*, assumes the form of a dipterous pupa, the *Leptomastix* thereby escaping many of its own parasitic enemies. The galls produced by many Diptera and Hymenoptera often bear some resemblance to fruit and so are not eaten by insectivorous birds, and frugivorous birds are driven off by the astringent taste of the tannin in the galls.

Experiments with infectious diseases for combating the chinch bug, L. BRUNER and H. G. BARBER (*Nebraska Sta. Bul. 34, pp. 143–161, pl. 1, figs. 13, map 1*).—Results of the work done in 1893 in distributing diseased chinch bugs to farmers in infested parts of the State. The bulletin is partially made up of quotations from the Kansas Station Report for 1891. To such farmers as sent in healthy bugs for inoculation were returned individuals attacked with the white fungus *Sporotrichum globuliferum*. Shipments were made to 164 different persons, a large percentage of them proving a success for destroying the chinch bugs.

The action of the fungus is described, as also that of the bacterial disease *Micrococcus insectorum*, and the gray fungus *Empusa aphidis*, both of which appeared and were more or less effective.

There are described and figured the following insects which have been mistaken for chinch bugs: False chinch bug (*Nysius angustatus*), gray plant bug (*Piesma cinerea*), large-eyed ground bug (*Geocoris bullata*), flea-like negro bug (*Corymelæna pulicaria*), clouded weed bug (*Trapezonotus nebulosus*), and *Emblethis arenarius*. As enemies are mentioned and figured *Nabis fusca*, *Geocoris bullata*, *Tachys* sp., *Hippodamia convergens*, *H. 13-punctata*, and *Coccinella 9-notata*.

There is appended a list of the persons to whom inoculated bugs were sent, with the results in each case.

Spraying, G. C. BUTZ (*Pennsylvania Sta. Rpt. 1892, pp. 130–133*).—Notes and tabulated data on spraying apple trees for the codling moth, and experiments with new insecticides and fungicides. Trees of Fallawater and Ben Davis were sprayed with London purple, 1 lb. to 200 gals. of water, and the gain in sound apples was nearly 100 per cent over the yield from trees not sprayed. Antinonnin, fostite, and par oïdium were experimented with, the first being deemed worthless, and the others, which are fungicides, not being sufficiently tested.

Miscellaneous entomological papers, F. M. WEBSTER (*Ohio Sta. Bul. 51, pp. 85–143, figs. 23*).—Popular articles, partly compiled, but also embodying much original investigation, on the asparagus beetle (*Crioceris asparagi*), western cornroot worm (*Diabrotica longicornis*), broad-striped flea beetle (*Systena tæniata*), blister

beetles (*Epicauta vittata, E. pennsylvanica, E. lemniscata, E. cinerea*, and *Macrobasis unicolor*), bag, or basket, worm (*Thyridopteryx ephemeræformis*), cabbage aphis (*Aphis brassicæ*), apple plant louse (*Aphis mali*), Hessian fly (*Cecidomyia destructor*), straw worm (*Isosoma tritici*), joint worm (*I. hordei*), chinch bug (*Blissus leucopterus*), white grubs (*Lachnosterna* spp.), corn, or boll, worm (*Heliothis armigera*,) cutworms (*Hadena devastatrix, H. stipata*, and *H. fractilinea*), and the lines of insect immigration. Descriptions, life histories, and remedies are given for the insects mentioned, and a concise summary appended embodying in compact and easily available form the main features elaborated previously.

Anatomy of the digestive tube of Hymenoptera, BORDAS (*Compt. Rend., 118 (1894), No. 25, pp. 1423, 1425*).—Technical descriptions of the alimentary apparatus.

Experiments with pure and crossed races of silkworms, E. QUAJAT (*Bol. Mensile Bachicolt., 12 (1894), No. 1, pp. 3–17*).—Tabulated data and discussion of results secured in experiments made in 1892 and 1893.

The use of sulphur fumes in rearing silkworms, E. VERSON (*Bol. Mensile Bachicolt., 12 (1894), No. 2, pp. 19–23*).—Report of results of an experiment made in 1893.

Homes of social insects, L. N. BADENOCH (*Pop. Sci. Monthly, 1894, July, pp. 338–345, figs. 5*).—Illustrated popular article on the nests of some tropical ants and wasps.

An insect gall of Chondrilla juncea, E. GAIN (*Bul. Soc. Bot. France, 41 (1894), No. 4, pp. 252–254*).—Descriptive notes on a two-lobed or three-lobed gall produced by a new species of *Cynipidæ, Aulax chondrillæ*.

Catalogue of gall insects and their host plants, A. NALEPA (*Spengel's Zoologische Jahrb., 7 (1893), pp. 247–327; abs. in Bot. Centbl., 59 (1894), No. 1 and 2, pp. 44–46*).—A technical paper.

The destruction of two-year old fir bushes by Strophosomus coryli, Otiorrhynchus septentrionus, and O. singularis, DR. ALTUM (*Ztschr. Forst. u. Jagdw., 26 (1894), No. 5, pp. 273–277*).—Descriptive and biological notes on these three beetles, which appear in May and June and lay their eggs among the fir roots, upon which the larvæ feed until August, when they pupate, emerging in the fall to pass the winter as adults. Deep and clean cultivation is advised where possible, and laying out boards and pieces of bark, under which the beetles hide during the day and from which they may be collected and destroyed.

Ravages of the Hessian fly in France, LABOULBÈNE (*Jour. Agr. Prat., 58 (1894), No. 26. pp. 928–930*).—Abstract of a paper read before the French National Agricultural Society, on the occurrence of *Cecidomyia destructor* and damage done by it in the northeast of France. Attention is called to the two yearly broods, and rotation of crops advised.

Unusual flights of the grouse locust (Tettigidea lateralis) in northeast Illinois, J. H. HANCOCK (*Amer. Nat., 28 (1894), No. 330, p. 483*).—Notes on this insect in the fall of 1893.

Invasions of true locusts; flight and ravages of Decticus albifrons, J. K. D'HERCULAIS (*Ann. Soc. Ent. France, 1894, No. 1, pp. 137–142*).—Account of recent attacks of the "Bon-Sag" in northern Africa and southern Europe, with some biologic notes.

Larvæ of oviparous Diptera feeding on the eggs of locusts, J. K. D'HERCULAIS (*Compt. Rend., 118 (1894), No. 24, pp. 1359–1361*).—*Idia* spp. deposit their eggs in the nests of *Acridium peregrinum*, after the manner of some Hymenoptera, and the larvæ devour the locust eggs.

Some viviparous Diptera with larvæ parasitic upon locusts, J. K. D'HERCULAIS (*Compt. Rend., 118 (1894), No. 20, pp. 1106–1108*).—Descriptive and biologic notes on the larvæ of *Sarcophaga* spp., which are deposited by the fly on the tip of the abdomen of *Acridium* spp., and burrow inward, destroying the generative organs and the muscles of flight.

Result of experiments with Botrytis tenella for the destruction of white grubs, J. DUFOUR (*Forst. naturw. Ztschr., 3 (1894), No. 6, pp. 249–255*).—Experiments

were made with larvæ in pots and in open ground, and though some of the larvæ in the pots were attacked by the fungus and died, the majority were exempt and very few died in the open ground. The conclusion was that the disease is epidemic in its virulence, as similar experiments in France had proved successful.

Note on Phyllium pulchrifolium, SAPPEY (*Compt. Rend., 118 (1894), No. 25, pp. 1393–1395*).—Anatomical notes on this walking leaf.

The green substance of Phyllium, H. BECQUEREL and C. BRONGNIART (*Compt. Rend., 118 (1894), No. 24, pp. 1299–1303*).—Investigations as to the nature of the coloring matter of the walking leaves (*Phasmidæ*), *Phyllium pulchrifolium* and *P. crurifolium* being made use of. It was found to dissolve in alcohol, and the solution was examined through the spectroscope. The bands were compared with those from a solution of the combined chlorophyll of various plants upon which the insects are known to feed, and found to almost coincide. The coloring consequently is stated to be chlorophyll, and its presence due to the leaves used as food.

Researches on the red coloring matter of Pyrrhocoris apterus, C. PHISALIX (*Compt. Rend., 118 (1894), No. 23, pp. 1282, 1283*).—Stated to be a substance closely related to carotin and without physiological action.

A scale insect on plums, S. A. BEACH (*Gard. and Forest, 7 (1894), p. 284, fig. 1*).—Note on *Lecanium cerasifex* attacking and destroying plums and a few other fruit trees in New York, with a photographic plate of an infested branch.

The San José scale in New Jersey, J. B. SMITH (*Ent. News, 5 (1894), No. 6, pp. 182–184*).—Note on the pest having been in New Jersey for several years undiscovered.

Further observations on the tea bugs (Helopeltis) of India, C. O. WATERHOUSE (*Trans. Ent. Soc. London, 1892, pt. 1, pp. 31, 32*).—Description and biologic notes, with accounts of continued damage, spring pruning and careful cultivation seeming to have no effect.

Tubercles upon potatoes, F. HEINS (*Ann. Soc. Ent. France, 1894, No. 1, pp. 29–32*).—*Lasius niger* perforates potatoes, causing lumps, but the tubers do not rot, probably on account of the formic acid secreted by the insect.

Methods for exterminating locusts in the Caucasus (*Kew Misc. Bul. 91, pp. 215, 216*).—Abstract of recommendations by the Russian Ministry of Agriculture. Burning, driving into trenches, and crushing with wattled hurdles and rollers are advised.

Poisons and the destruction of insects, A. LARBALÉTRIER (*Jour. Agr. Prat., 58 (1894), No. 26, pp. 927, 928*).—Brief notes on experiments on caterpillars with various poisonous chemicals and the unsatisfactory results.

Preservation of books in the tropics (*Kew Misc. Bul. 91, pp. 217, 218*).—In Calcutta libraries the books are protected against white ants by placing the shelves on stone insulators, and against other insects by disinfecting with naphtha, lightly brushing with kerosene or an alcoholic solution of corrosive sublimate, and placing naphthalene in the cases.

FOODS—ANIMAL PRODUCTION.

Does chemical analysis afford a reliable indication of the feeding quality of a pasture? A. P. AITKEN (*Trans. Highland and Agl. Soc. Scotland, 1891, pp. 410–425*).—To answer this question very complete analyses were made of the grass from 17 pastures and of the soils and subsoils of these pastures. In the fodder analyses the water, ash, fiber, total protein, albuminoids, amids, and ether extract were determined, together with the total solids, carbohydrates, protein,

and ash extracted with 1.25 per cent sulphuric acid and with 1.25 per cent caustic potash solution. The author's answer to the above question is that "except in cases where the difference in the feeding value of pastures is very slight, the chemical analysis of the grass by the methods here employed affords fairly reliable information, and that information is increased and made still more reliable by the analysis of the soil. Further, it is probable that if we could get what might be regarded as a fair sample of that portion of the grass which is really eaten by stock, any slight discrepancies such as have been noted might disappear. There is some additional information derivable from the separate estimation of the protein, and perhaps also of the ash contained in that portion of the grass that is soluble in a weak solution of acid and that which is not; but it would require a larger induction than what is here afforded to draw any definite conclusion regarding that point. It is probable also that the separation of the carbohydrates into various classes may yet provide useful information in the way of gauging the feeding value of fodders."

Feeding stuffs (*Connecticut State Sta. Rpt. 1893, pp. 238–251*).—Analyses are given of wheat hay, rye hay, corn meal, gluten meal, corn bran, germ feed, gluten feed, hominy chops; wheat bran from winter wheat, spring wheat, white wheat, red wheat, and Canada wheat; middlings from red wheat, winter wheat, and spring wheat; wheat feed, oat feed, oat middlings, provender, oat and corn feed, buckwheat flour, buckwheat bran, buckwheat feed, ground rye, rye feed, and damaged barley; cotton-seed meal, decorticated and undecorticated; linseed meal, old and new process; pea meal, proteina, special cow feed, Pratt's food for horses and cattle, special mill feed, elevator screenings, and "nutriotone." Analyses of some of these are given in the following table:

Analyses of feeding stuffs.

	Water.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Wheat hay	11.29	3.10	4.61	30.25	49.36	1.39
Rye hay	10.24	4.02	5.81	38.36	40.28	1.29
Do	9.52	3.83	5.21	37.68	42.22	1.54
Do	10.27	5.28	6.71	37.83	38.67	1.24
Chicago gluten meal	8.43	.62	38.94	.85	45.14	6.02
Chicago corn bran	8.24	.40	11.19	12.10	59.22	8.85
Pope's cream gluten meal	8.49	.65	38.56	1.12	37.27	13.95
Do	6.84	.55	35.00	1.00	43.21	13.40
Pope's germ feed	7.26	.50	11.25	12.49	58.04	10.46
Buffalo gluten feed	8.04	.40	24.87	7.45	48.16	11.08
Do	11.58	.67	22.62	6.83	44.93	13.37
Proteina	9.80	2.03	23.50	8.47	47.20	9.00
Do	9.56	2.37	24.06	9.42	45.66	8.93
Special cow feed	10.68	1.86	13.56	6.77	61.03	6.10
Pratt's food for horses and cattle	10.80	4.22	16.99	4.90	57.26	5.83
U. S. Milling Co.'s special mill feed	8.00	3.03	14.94	4.27	63.71	6.05
Elevator screenings	11.27	5.07	16.50	10.55	52.34	4.27
Nutriotone	7.72	19.41	22.12	6.97	37.76	6.02

"Wheat hay, sowed September 20, 1892, after potatoes, top-dressed in the winter, cut June 24, when the seed was just going into the dough stage; cured in good

order and put into the barn June 30. The stubble was immediately turned under for corn. Yield, about 2 tons per acre.

"Rye hay (1), sowed September 6, 1892, after corn. Cut June 3, 1893; cured in good order and put into barn June 6. Yield, about 1½ tons per acre.

"Rye hay (2), sowed September 28, 1892, after corn, which yielded 24 tons per acre. Cut June 8, 1893; cured in good order and put in barn June 10. Yield, about 2 tons per acre.

"Rye hay (3), sowed after corn October 11, 1892. Cut May 22, 1893, to clear the ground for corn. This was poorly cured; rained on while spread. Yield, about 1 ton per acre.

"The analyses indicate that these cereal crops, cured as hay, have, with the exception of rye hay (3), rather less protein and more fiber than average hay from mixed meadow grasses.

"The higher content of protein in [rye hay (3)] as well as its smaller yield per acre, are explained by the fact that it was cut earlier than the other lots. . . .

"[The by-products from maize meal] mostly come from the factories of starch and glucose, of which the 5 largest in the United States together are said to be able to work up 120,000 bu. of corn daily. Glucose is made by chemical treatment of starch. The preliminary processes by which the starch is separated from the other parts of the kernel are essentially the same in all factories, and are stated by the representative of one of them to be as follows:

"The corn is ground with water between stones and first passed over sieves which retain the hull or chaff, while the starch mixed with the so-called 'gluten' runs to settling tanks. The starch, being specifically heavier than the gluten, sinks to the bottom, while the gluten lies above the starch. When both have completely settled, the clear water first, and next the gluten, are run off, leaving the starch. . . .

"The Chicago gluten meal is the clear gluten from the settling tanks, dried and perhaps ground. . . .

"The Chicago maize feed is a mixture of gluten meal and hulls, not dissimilar to Buffalo gluten feed.

"The Chicago corn bran consists of the hulls left on the sieves and of the corn chits, or germs, from which the oil has been partly extracted. . . .

"Pope's germ feed is very like the Chicago corn bran in its origin and composition. . . . Buffalo gluten feed consists of all those parts of the kernel not directly used to make glucose and contains, therefore, all the 'gluten,' hulls, and oil of the kernel. This gluten feed is a more concentrated food than wheat bran, containing some 6 per cent more of protein and two or three times as much oil as the latter, and more nonnitrogenous extract with less fiber and mineral matter. . . .

"['Proteina'] appears to be a mixture of corn, oat hulls, linseed meal, and perhaps gluten meal.

"It may be most fairly compared, as far as chemical composition goes, with Buffalo gluten feed, but its price is, at present rating ($25), too high to make it an economical feed.

"Special cow feed is said to be composed of 40 lbs. of gluten meal, 40 lbs. of hominy chops, 15 lbs. of oats, and 5 lbs. of linseed meal in every 100 lbs.

"Assuming that the 'gluten meal' of the formula is gluten feed with 22 per cent of proteids instead of 36 or 38, such a formula ought to make a considerably richer feed, containing some 4 per cent more of protein, than is in the sample. . . .

"The analysis [of the special-made mill feed] shows it to be a less concentrated feed than wheat bran. In the circular received from the manufacturer nothing is stated as to the ingredients which enter into this 'special-made feed.' . . .

"[Elevator screenings are] used chiefly as poultry food, but to some extent for cattle. It is to be judged rather by inspection than chemical analysis. It consists of damaged grain mixed with seeds of cockle and a host of other weeds. Its use either for poultry or cattle makes pretty certain a further seeding of the farm with noxious weeds. . . .

"['Nutriotone'] contains a considerable quantity of some leguminous seed, some linseed meal, and perhaps other feeding stuffs, together with aromatic substances (fenugreek, aniseed, caraway, and the like), and over 10 per cent of salt. The analysis shows its value in a general way as a feed. The material, however, is claimed to be rather in the nature of a tonic having medicinal properties than of a feeding stuff, as is judged from the fact that the prescribed dose for cattle is 2 tablespoonfuls with each feed."

The market price and the valuation are given for all the feeding stuffs analyzed except the wheat hay and rye hay. The valuation is calculated on the basis of protein at 2.3 cts., nitrogen-free extract and fiber at 0.94 ct., and fat at 1.14 cts. per pound, which was found to be the cost of these materials in the concentrated feeding stuffs examined.

On the composition and digestibility of the nitrogen-free extract of corn fodders and of pasture grass, W. FREAR and W. S. SWEETSER (*Pennsylvania Sta. Rpt. 1892, pp. 44–50*).—The glucose, sucrose, starch, and residual extract in the nitrogen-free extract of sweet-corn fodder, dent-corn fodder, and pasture grass were determined, and the digestibility of these was determined in experiments with sheep and steers. The average compositions of the nitrogen-free extracts were as follows:

Composition of nitrogen-free extract of several fodders.

	Total nitrogen-free extract in dry matter.	In 100 parts of nitrogen-free extract.			
		Glucose.	Sucrose.	Starch.	Residual extract.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Sweet-corn fodder, kernels in milk	47.80	15.39	14.39	20.37	49.85
Young dent-corn fodder, ears not formed	44.34	23.01	6.36	17.06	53.57
Older dent-corn fodder, kernels glazing	55.33	32.13	0.36	21.20	46.31
Pasture grass	41.53	13.70	5.44	20.90	59.96

The coefficients of digestibility found were as follows:

Mean coefficients of digestibility of nitrogen-free extract.

	Total extract.	Nitrogen-free extract.		
		Starch.	Sugar and starch.	Residual extract.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Sweet-corn fodder, kernels in milk; with sheep	80.50	84.76	94.71	66.98
Dent-corn fodder, ears not formed; with sheep	74.95	76.66	91.59	60.70
Dent-corn fodder, kernels glazing; with sheep	77.78	79.71	92.11	61.31
Pasture grass; with steers	75.48	87.06	93.27	62.15

"The starch of corn fodder, in general, is found to be more digestible than that of the grasses examined by Jordan, as is also that of the pasture grass, though in the latter case a different species of herbivora was used in the experiment.

"The residual extract of the sweet corn is more digestible than that of the dent samples, though the average digestibility of this portion of the total extract is not far from that found by Jordan in the cases of grasses and clovers."

On the food value of herring cakes and whale-flesh meal, F. H. WERENSKIOLD and E. SOLBERG (*Norsk Landmandsblad, 13 (1894), pp. 185, 186; Rpt. Chem. Control Sta. Christiania, 1893, pp. 50, 51*).—Samples of Norwegian herring cakes and whale-flesh meal were subjected to chemical examination, including determination of digestible nitrogenous components (according to Stutzer's method). The main results are given in the following table, and, for comparison, an analysis of a whale-flesh meal made by Stutzer in 1884:

Analyses of herring cakes and whale-flesh meal.

No.		Water.	Ash.	Fat.	Crude protein.	Other sub-stances.	Amids.	Digesti-bility of protein.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
1	Herring cakes	9.16	18.85	12.69	56.00	3.57	4.86	69.5
2	Whale-flesh meal	10.58	8.34	19.90	58.62	2.56	13.81	89.3
3	......do	9.40	3.84	18.54	68.22	....	9.68	82.1

If the total digestible protein be compared in case of samples 2 and 3, we find that sample 3 contained 3.66 per cent more of digestible nitrogenous substances than 2, and 7.77 per cent more of digestible albuminoids. In the report of the Christiania Station for 1893 the authors call attention to the fact that the quality of the whale-flesh meal on the market has deteriorated of late years through carelessness on the part of the manufacturers in removing the oil. The following analyses of whale-flesh meal corroborate the conclusion drawn:

Fat and protein in whale-flesh meal.

	Fat.	Protein.
	Per cent.	*Per cent.*
Samples analyzed during 1889	16.5–21.2	67.9–70.8.
Samples analyzed during 1892	15.5–20.5, average 16.6	59.2–66.7, average 63.1.
Samples analyzed during 1893	11.5–29.7, average 24.0	51.3–65.9, average 58.3.

—F. W. WOLL.

The relative nutritive values of mangel-wurzels and sugar beets, P. GAY (*Ann. Agron., 20 (1894), No. 4, pp. 200–207*).—Ten Merino sheep divided into 2 lots were used. Both lots received the same kind and amount of coarse fodder and roots containing 420 gm. of dry matter per head daily. This dry matter was supplied to one lot in the form of mangel-wurzels containing 14 per cent dry matter and to the other lot in the form of sugar beets averaging 19 per cent dry matter. At the end of 2 weeks the feed for the lots was reversed. With both lots the dry matter of sugar beets had a superior nutritive effect, the average gain in live weight due to sugar beets being about 20 per cent greater than the increase resulting from feeding mangel-wurzels.

The food value of forage corn, H. P. ARMSBY (*Pennsylvania Sta. Rpt. 1892, pp. 22–34*).—A study of the influence of variety, rate of seeding, and time of harvesting forage corn upon digestibility and yield. In thick seeding 1 kernel was planted every 6 in.; in thin seeding 1 kernel every 18 in. The varieties grown were a local dent variety and Breck Boston Market Ensilage, a variety which at the station barely reaches the glazing stage before frost.

The following table gives a summary of the yields per acre of digestible matter secured in 1891 and 1892:

Digestible matter in thin-seeded and thick-seeded corn cut at different stages.

	Stage of maturity.	Digestible albuminoids.	Digestible non-albuminoid matter.	Total digestible matter.	Nutritive ratio.
1891.		*Pounds.*	*Pounds.*	*Pounds.*	
Thin-seeded dent	Silking	82	916	1,008	1:11.9
Do	Glazing	136	2,677	2,813	1:20.5
Do	Nearly mature	209	2,873	3,082	1:14.5
Thick-seeded dent	Glazing	200	4,337	4,537	1:23.1
Thin-seeded Breck	Dented and hardening	215	3,776	3,991	1:18.1
Thick-seeded Breck	Milk	314	6,180	6,494	1:20.3
1892.					
Thin-seeded dent	Silked	132	1,821	1,953	1:13.4
Do	Glazing	140	2,729	2,869	1:19.5
Do	Mature	237	3,676	3,913	1:16.2
Thick-seeded dent	do	164	4,863	5,027	1:30.9
Thin-seeded Breck	Hardening	111	3,998	4,109	1:36.5
Thick-seeded Breck	Just past milk stage	110	4,479	4,589	1:41.4

"*Influence of maturity.*—As the corn crop approaches maturity there is a very rapid increase in the yield of dry matter per acre, while the digestibility of this dry matter appears to increase slightly, rather than to decrease as in the case of other crops. The yield of total digestible food by the fully mature crop was from two to three times as great as that by the same variety in the silking stage, and (in 1892) 36 per cent greater than at the time the ears were glazing.

"*Influence of rate of seeding.*—The thicker seeding in these experiments produced in every instance a greater yield both of dry matter and of digestible food. The effect on the digestibility of the crop varied somewhat in the different experiments, but the digestibility seemed to be influenced more by the relative maturity of the crops than by the rate of seeding.

"*Influence of variety.*—Of the 2 varieties used, the large corn gave the greater yield of both dry matter and digestible food than the small corn cut at the same stage of maturity. When cut at the same time, the small corn, being more mature, gave a relatively greater yield of food, which in one case exceeded that of the large variety."

Experiments with corn fodder, T. F. HUNT and W. H. CALDWELL (*Pennsylvania Sta. Rpt. 1892, pp. 34–43*).

Synopsis.—An experiment as to the best stage for cutting green corn fodder, as shown by the butter fat produced when the fodder was fed to cows. The results favored cutting when the corn was medium mature—leaves beginning to dry, husks green, and kernels mostly dented. Pound for pound the corn fodder in this stage was found to be equal to good timothy hay, although only about four fifths of the fodder was eaten, and the lot on hay made a gain in live weight.

A field of 2½ acres of Queen of the Prairie, a medium-maturing dent corn, was used. Portions of this were cut at 3 different dates as follows: (1) Early cut, September 1, leaves and husks green, kernels mostly in milk; (2) medium mature, September 25, leaves partly dead, but most husks green, kernels glazing to dented or quite hard; (3) late cut, October 7, leaves and husks mostly dry and kernels mostly hard. Twenty-four shocks from an area 30 by 35 ft. were cut at each stage.

Beginning November 9 the fodder (ears and stalks) was fed to 12 cows, that cut at each date being fed to a lot of 4 cows, while a fourth lot received timothy hay in place of the fodder. In a preliminary period the lots were compared for 1 week, all receiving the same kind of fodder. In the experiment proper all lots received 3 lbs. of wheat bran and 3 lbs. of ground oats per head daily, and the corn fodder or hay was fed *ad libitum*. The corn fodder was hauled from the field as needed.

"The corn fodder of the early cutting fed 37 days, and, together with 444 lbs. of ground oats and an equal quantity of bran, produced 100.5 lbs. of butter fat. The corn fodder of the medium-mature cutting fed 45 days, and, together with 540 lbs. of ground oats and an equal quantity of bran, produced 119.5 lbs. of butter fat. The corn fodder of the late cutting fed 44 days, and, together with 528 lbs. of ground oats and an equal quantity of bran, produced 110 lbs. of butter fat.

"At this rate an acre of corn fodder, together with the quantities of oats and bran given, would produce butter fat as follows:

Yield of butter fat per acre of corn fodder cut at different stages.

	Ground oats.	Bran.	Butter fat.
	Pounds.	*Pounds.*	*Pounds.*
Early-cut corn fodder	785	785	174
Medium-mature corn fodder	933	933	207
Late-cut corn fodder	913	913	190

"If it is assumed, for the purpose of comparison, that an acre of corn fodder costs \$20, the ground oats \$1 per 100 lbs., and bran 70 cts. per 100 lbs., then the butter fat produced from the early cutting costs 19.2 cts. per lb., that from the medium-mature cutting 17.3 cts., and that from the late cutting 18.7 cts. per lb.

"During the period under consideration lot 2 lost 23 lbs. per lot of 4 animals, lot 3 lost 18 lbs., while lot 4 gained 5 lbs. . . . .

"The cows fed on medium-mature corn fodder produced the largest quantity of butter fat at the least cost; the late-cut corn fodder stood next both as to quantity and cost of butter fat, while the early-cut corn fodder gave the poorest results."

The lot fed medium-mature corn fodder for 45 days was compared with the lot fed good quality of timothy hay instead for a like period. The former ate 4,102 lbs. of corn fodder and 1,080 lbs. of grain (bran and oats) and produced 119.5 lbs. of butter fat, while the latter ate 4,237 lbs. of hay and a like amount of grain and produced 116 lbs. of butter fat. Pound for pound, the corn fodder produced more butter fat than the hay; but the lot on hay gained 84 lbs., while the lot on corn fodder lost 23 lbs., and only about four fifths of the corn fodder was eaten.

Yield of corn fodder at different stages of ripeness (pp. 41–43).—In the above experiment 12 additional shocks from each stage of cutting were used for determining the yield.

"There were about $3\frac{3}{8}$ tons of air-dry corn fodder from the late cutting, almost exactly 3 tons in the medium-mature cutting, while in the early cutting the yield was a little more than 2 tons of air-dry corn fodder."

The losses of dry matter in field-curing and storing in the barn are given.

Influence of ensiling and field-curing on the digestibility of forage corn, H. P. ARMSBY (*Pennsylvania Sta. Rpt. 1892, pp. 14–22*).—The coefficients of digestibility for green corn fodder and the same ensiled, as shown by experiments with steers and sheep, are reported.

"The results of the experiments may be summed up as follows:

"(1) The ensiling of maize may considerably increase the digestibility of the crude fiber of the green material.

"(2) This result is only obtained when the loss by fermentation is so large that the crude fiber is attacked, and is at the cost of a decreased digestibility of every other important ingredient.

"(3) The albuminoids are especially affected by ensiling, a considerable proportion of them being converted into less valuable forms and the digestibility of the remainder being reduced sometimes nearly or quite to zero.

"(4) Such silage may be considerably more digestible than poorly cured fodder, except as to the albuminoids.

"(5) Field-curing seems in every case to decrease the digestibility of the fresh substance.

"(6) When the processes are successfully conducted and the losses small, ensilage and field-curing both decrease the digestibility of the fresh material somewhat, and to about the same extent."

Results obtained elsewhere in this country and abroad are cited.

Relative feeding value of turnips grown with and without nitrate of soda, A. S. LOGAN (*Trans. Highland and Agl. Soc. Scotland, 1894, pp. 332–335*).—In 2 years, 1892 and 1893, turnips were grown on 2 plats manured alike, except that 1 plat received nitrate of soda as a top-dressing while the other received none. In 1892 150 lbs. of nitrate of soda was applied July 21, and in 1893 the same amount was applied July 13 and again August 4. The yield of turnips per acre was larger in both years on the nitrated plat—about 8,000 lbs. more in 1892 and 2,300 lbs. in 1893. The composition of the turnips was as follows:

Composition of turnips grown with and without nitrate of soda.

	1892.		1893.	
	Without nitrate.	With nitrate.	Without nitrate.	With nitrate.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Water	92.30	92.58	91.12	92.06
Albuminoids	.59	.71	.47	.66
Amids, etc	.18	.34	.25	.24
Carbohydrates	5.52	4.98	6.49	5.44
Fiber	.77	.72	1.06	.93
Ash	.64	.67	.61	.67
	100.00	100.00	100.00	100.00

Calculating the results to dry matter it is found that in 1892 the turnips contained 7.66 per cent of albuminoids in dry matter when grown without nitrate and 9.57 per cent when grown with; and in 1893 5.29 and 8.31 per cent, respectively.

The turnips in both years were fed to sheep, one lot being fed on the crop grown with and the other on the crop grown without nitrate of soda. Although they were fed *ad libitum*, practically the same amount was eaten by each lot. In 1892 the lot on turnips grown without nitrate gained 320 lbs. from December 27 to April 4, and the lot on turnips grown with nitrate gained 264 lbs.; and in 1893 the gains from October 24 to January 6 were 221 and 229 lbs., respectively. In both years the dressed weight was largest in the case of the lot fed on turnips grown without nitrate. In the opinion of the author the turnips grown without nitrate had the higher feeding value, although the yield was smaller. "The extra quantity grown per acre by the use of nitrate would have been available for a longer time. In the first experiment this would have been 3 weeks; and during that time, according to the rate of increase of live weight, the sheep would have equaled the others, but there would still have remained the feeding value of the artificial food consumed against the nitrated turnips."

The effect of foods on milk production, J. SPEIR (*Trans. Highland and Agl. Soc. Scotland, 1894, pp. 83–108*).—The author reports experiments with cows on pasturage, brewers' grains, potatoes, bean meal, wheat, cotton-seed cake, barley meal, linseed cake, and a variety of mixed rations. The milk was tested frequently with the Leffmann and Beam tester. The object was to note the effect of the above feeding stuffs in large amounts on the fat of the milk. The author's conclusions are as follows:

"(1) Really good milking cows will lose in weight of body for some weeks after calving, no matter what is the quantity or quality of their food.

"(2) When a cow in good condition is in full milk she will give her normal quality of milk at least for a limited time, even although the quantity or quality of her food be deficient.

"(3) When in good condition a heavy milking cow will take flesh or fat off her body in order to give her normal quality of milk.

"(4) Although the quantity of milk is easily influenced up to a certain point by the food supplied the quality is not materially altered by any ordinary mixed food.

"(5) The proportion of butter fat is very little influenced by foods containing a large percentage of oil, such as linseed or cotton cake, nor yet by albuminous foods, such as bean or pea meal, decorticated cotton cake, etc.

"(6) Highly albuminous foods have a slight influence on the solids-not-fats.

"(7) Any increase in quantity or quality of milk over the present normal standard is to be looked for more from breeding than from feeding.

"(8) If the food ingredients are present in sufficient quantity in a state palatable to the animal and easily assimilated it does not seem to make much difference from what source they come.

"(9) The aim of all producers of milk should therefore be to use foods which will produce quantity more than quality, provided that they contain no taint or flavor which can be conveyed to the milk.

"(10) Leaving nutritive ingredients out of account none of the foods used seem to have had any very special effect in increasing the quantity."

Shelter for sheep, J. SCOTT (*Trans. Highland and Agl. Soc. Scotland, 1894, pp. 109–133*).—A number of practical experiments on this subject showed that "shed-wintered sheep eat much less and yet produce much more mutton in proportion to the quantity of food consumed than others fed in the open field, exposed to all varieties of weather, and inclined to take much more exercise."

Feeding wheat to hogs, E. C. CHILCOTT (*South Dakota Sta. Bul. 38, pp. 16, plates 5*).

Synopsis.—Spring wheat, ground and unground, ground peas, and ground corn were compared on 4 lots of 2 pigs each for 90 days. Hay and corn fodder were fed with each grain. Peas gave the largest gain for the food eaten, followed by corn, ground wheat, and unground wheat in the order named. With dressed pork at 5½ cts. per pound from 55 to 58 cts. per bushel was realized for the wheat, 60 cts. for the corn, and 65 cts. for the peas. The pigs were fed too long to secure the best financial results, some lots averaging 225 lbs. at the close of the trial.

To ascertain the feeding value of whole and ground wheat as compared with peas and corn 8 pigs were fed in 4 lots for 90 days beginning September 5. The lots were fed hay and corn fodder (without ears) and the following grain *ad libitum:*

Lot 1, Canada field peas, ground.
Lot 2, spring wheat of rather poor quality, unground.
Lot 3, Dakota-grown dent corn, ground.
Lot 4, spring wheat, same as lot 2, ground.

The grain for all was soaked in cold water before feeding. A fifth lot received kitchen slop, sour milk, whey, corn, peas, and wheat, and no account was kept of the food eaten.

There were 4 Poland Chinas and 4 crosses of Poland China with Duroc Jersey. The pigs ranged from 80 to over 100 lbs. in weight. Previous to the experiment they had been at pasture or fed on rape, and received some grain in addition. They were bought at 4½ cts. per pound, live weight, and sold at the close of the experiment at 5½ cts., dressed weight. The pigs were slaughtered at the close of the experiment, and plates showing sections of the carcasses are given. At that time the live weights ranged from 191 to 222 lbs.

The results are stated in 3 periods of 25, 28, and 37 days, respectively. The average results by lots for the whole experiment were as follows:

Summarized results of experiments with pigs.

	Weight of lot at beginning.	Average daily gain per pig.	Total grain consumed by lot.	Grain eaten per pound of gain.	Average gain—Per 100 pounds of grain.	Average gain—Per bushel of grain.	Price realized per bushel of grain.	Shrinkage in dressing.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Cents.*	*Per ct.*
Lot 1, ground peas	164	1.21	918	4.21	23.75	14.25	65.36	17.0
Lot 2, unground wheat	174	1.12	997	4.91	20.36	12.22	55.83	17.0
Lot 3, ground corn	191	1.40	1,159	4.58	21.83	12.22	60.00	14.0
Lot 4, ground wheat	205	1.32	1,144	4.81	20.79	12.49	58.39	16.5
Lot 5, mixed feed	229	1.61						14.8

"If wheat did not bring more than 50 cts. a bushel at harvest time and hogs weighing from 50 to 100 lbs. each could be bought for $4.50 per hundred live weight, the farmer could go into the market and purchase such hogs and start, about September 1, feeding them on wheat alone, under substantially the same conditions existing during this experiment, with a fair prospect of realizing from 55 to 60 cts. per bushel for his wheat. . . . It would undoubtedly pay better to mix it with some other food, particularly during the earlier stages of fattening.

"Hogs fed on ground wheat made a more rapid and uniform gain, and produced pork of rather nicer quality; but they also consumed more food than those fed upon whole wheat. [The extra gain] would hardly pay for grinding, but considering the better quality of the pork and greater weight, it would probably pay to grind, if it could be done without much extra cost. . . .

"Hogs fed on peas did much better, in proportion, during the first part of the experiment than they did during the latter part, which would indicate that peas are not as good for a complete ration for a long period as either wheat or corn.

"The quality of the pork made from corn and ground wheat was about equal, and was superior to that made from whole wheat, peas, or mixed food. That made from mixed food was the fattest. [Contrary to the general rule] the number of pounds of food required for a pound of gain was greater during the first period than during the second. . . . The most reasonable explanation of this circumstance is that it was caused by the sudden change from plenty of exercise and a mixed diet to close confinement and a single article of food. . . .

"It was very plainly demonstrated that a considerably larger return per bushel for food consumed would have been realized if the hogs had been sold at the end of the second period (October 28). This was particularly true of lot 1, fed on peas."

Do the ferments occurring in vegetable materials affect the digestibility of these materials in the body? H. WEISKE (*Ztschr. physiol. Chem., 19, No. 3, pp. 282–284*).—It is known that certain vegetable materials contain amylolytic, proteolytic, and other ferments which under favorable conditions have a digestive action on these materials both without and within the body, but which are rendered inactive by heating. Ellenberger and Hofmeister especially have demonstrated that both amylolytic and proteolytic ferments are widely diffused in grains as oats, corn, rice, etc.; and that when these grains are fed raw a large part of the sugar production in the stomach is attributable to the amylolytic ferment in the grains.

The author reports an experiment on this point, already noted (E. S. R., 6, p. 66), in which rabbits were fed on raw oats, and oats heated to 100° C. to destroy the ferment. The heating did not appear to have any effect upon the digestibility of the oats, and the author infers that under normal conditions the presence of digestive ferments in the food does not render the digestion in the body more complete.

Horse feeding (*Ugeskr. Landm., 39* (*1894*), *p. 232*).—A writer states that wheat is far preferable to rye as a feed for horses, and that it ought to be used more extensively than is now the case, *e. g.*, in mixtures of equal weight of oats and wheat for work horses.

According to the same issue of the *Ugeskrift*, it seems of late to have become a more general practice in Europe to substitute Indian corn for oats as horse feed, but not for riding horses and light carriage horses. The 10 larger street-car companies in England, according to *Magdeburg Zeitung*, feed their horses, on an average, 4.55 kg. of Indian corn, 2.4 kg. of oats, 1.2 kg. of beans and peas, and 0.15 kg. of wheat bran.

The street-car company of Leipsic feed their horses 5.5 kg. of corn and 1.5 kg. of oats; the horses are able to work as well as before on an exclusive oat diet, are in better condition, and have a smooth, shiny coat. J. Jensen, Danish state instructor in animal husbandry, states that "it is to be regretted that a field of such vast economic importance as the feeding of horses has not yet been the object of comprehensive and careful experiments, so that the relative feeding value of the various cereals as food for horses might be stated definitely. It seems evident from the experiments made, however, that the nutritive value and importance of oats as a food for work horses has been overestimated, as, in fact, the value of the nitrogenous feeds in general."—F. W. WOLL.

Analyses of feeding stuffs (*Massachusetts State Sta. Bul. 52, pp. 6, 7*).—Tabulated analyses are given of mixed horse feeds, cotton-seed meal, maize feed, gluten meal, gluten feed, germ feed, wheat bran, oat feed, and ground oats.

Analyses of cattle foods, F. H. WERENSKIOLD (*Rpt. Chem. Control Sta. Christiania, 1893, pp. 31–52*).—Analyses are given of 278 samples of feeding stuffs—as cotton-seed meal, peanut-cake meal, rape-seed meal, linseed meal, whale-flesh meal, etc. Discussions are entered on in the report concerning the quality of the various food stuffs, origin, adulterations, etc.—F. W. WOLL.

Analyses of maize kernel (*Connecticut State Sta. Rpt. 1893, pp. 301–313*).—Analyses with reference to food ingredients are given of 90 samples of corn kernels, together with data regarding the weight of kernel and cob, ratio of kernel to cob, date of planting, character of soil, method of cultivation, etc. The samples were those collected for the Connecticut exhibit at the World's Fair. No deductions are made from the analyses.

Proteids of the wheat kernel, T. B. OSBORNE and C. L. VOORHEES (*Connecticut State Sta. Rpt. 1893, pp. 175–185*).—This is a reprint from part IV of the Annual Report of the station for 1893 (E. S. R., 5, p. 1079).

The proteids of cotton seed, T. B. OSBORNE and C. L. VOORHEES (*Connecticut State Sta. Rpt. 1893, pp. 211–217*).—This is a reprint from part IV of the Annual Report of the station for 1893 (E. S. R., 5. p. 1081).

The proteids of the kidney bean, T. B. OSBORNE (*Connecticut Sta. Rpt. 1893, pp. 186–210*).—This is a reprint from part IV of the Annual Report of the station for 1893 (E. S. R., 5, p. 1080).

The food value of pure Graham bread, BARDET (*Jour. Pharm. et Chim., 14 (1894), No. 12, pp. 621, 622*).

Table oils from beech and linden (*Kew Misc. Bul. 91, pp. 218, 219*).

Slaughter experiments at the twentieth fat stock show at Berlin, C. LEHMANN (*Deut. landw. Presse, 21 (1894), No. 52, pp. 517, 518*).—A comparison of live weights with dressed weights of different breeds of sheep and swine.

Potatoes as a food for milch cows, C. CORNEVIN (*Jour. Agr. Prat., 58 (1894), No. 28, pp 46, 47*).—A condensed statement of results of an experiment to determine the effect of potatoes on quality of milk and on the weight of milch cows.

Potatoes as a food for beef cattle and sheep, A. GIRARD (*Jour. Agr. Prat., 58 (1894), No. 28, pp. 43–46*).—Experiments to determine gain in live weight and quality of flesh produced.

Feeding disembittered lupines to horses and cows, G. KAISER (*Deut. landw. Presse, 21 (1894), No. 54, p. 537*).—The record of a favorable experience.

Poultry industry in England, W. FREAM (*Jour. Roy. Agr. Soc. England, ser. 3, 5 (1894), pp. 290–303*).

On the total energy brought into play in the organism by the combustion of albuminoids, C. MATIGNON (*Bul. Soc. Chim. Paris, 11–12 (1894), No. 12, pp. 568–571*).—A critical discussion of the work principally of Berthelot and André and of Petit.

The principle of maximum work and of entropy, BERTHELOT (*Compt. Rend., 118 (1894), No. 25, pp. 1378–1392*).

VETERINARY SCIENCE AND PRACTICE.

Laws of Massachusetts regarding contagious diseases among domestic animals (*pp. 27*).—An act to codify and consolidate the laws relating to contagious diseases among domestic animals was passed by the legislature of Massachusetts and was approved June 20, 1894. Under the new law towns and cities are to appoint inspectors subject to the local boards of health and to the State board of cattle commissioners. These inspectors are required to inspect regularly and thoroughly all neat cattle within their jurisdiction, and they are further charged with the duty of inspecting all domestic animals which are suspected of having been exposed to contagious diseases. They also have the power of quarantine and make returns to the board of cattle commissioners. Under the authority of the local boards of health they may inspect the carcasses of all slaughtered animals and all meat, fruit, vegetables, or produce of any kind, which, if found unfit for food, they may seize and dispose of. Calves less than 1 month old are condemned as unfit for human food, and a fine or imprisonment, or both, is provided for any one selling unwholesome food. The local boards of health may publish the names of persons convicted of offering such food.

Slaughter houses and kindred establishments must take out a town or city license, under which the nature of the products which will be sold, the estimated number of cattle to be slaughtered weekly, and the days of the week on which slaughtering will be done must be given. Inspectors shall be present on the days of slaughtering, and it is illegal for slaughtering to be done on any other days than those named in the license.

Animals slaughtered on private premises must be inspected either at the time of slaughter or in the preceding 6 months.

The local boards of health may regulate the movement of cattle within their jurisdiction. If quarantine is effected on the owner's premises he shall defray the expense; if elsewhere, the city or town shall bear the cost, of which, however, four fifths shall be refunded by the State. The land and stables of an owner may be used for quarantine purposes for the term of 1 year, the resulting damage to be paid by the town or city, four fifths of which amount, however, will be reimbursed to the municipality by the State.

The State board of cattle commissioners is authorized to make regulations concerning the extirpation, prevention, and suppression of contagious diseases, inspection of animals and animal products, and governing quarantine and disinfection.

The board of cattle commissioners or any of its members, after an examination of a case of contagious disease among domestic animals, may have the animal quarantined at the expense of the owner, or may

have it killed without appraisal or payment. The expense of killing and burying is borne by the State. If after slaughter the animal proves free from the disease for which it was condemned a reasonable sum shall be paid to the owner by the State: "*Provided, however*, That whenever any cattle afflicted with the disease of tuberculosis are killed under the provisions of this section one half of the value thereof at the time of slaughter for food or milk purposes, and without taking into consideration the existence of such disease, shall be paid to the owner thereof out of the treasury of the Commonwealth if such animal has been within the State 6 months continuously prior to its being killed, provided such person shall not have, prior thereto, willfully concealed the existence of tuberculosis or by act or willful neglect contributed to the spread of such disease."

Cattle coming into the State from other States may be seized and quarantined at the expense of the owners or consignees, or may be killed without appraisal or payment for the same. Texas cattle or other cattle of this class shall not be driven outside the stock yards contrary to an order of the board of cattle commissioners, and such cattle shall be kept in different pens from those in which other cattle are kept.

The contagious diseases covered by this act are glanders, farcy, contagious pleuro-pneumonia, tuberculosis, Texas fever, foot-and-mouth disease, rinderpest, hog cholera, and rabies.

Experimental study of symptomatic charbon and its relations to malignant œdema, H. DUENSCHMANN (*Ann. Inst. Pasteur, 8 (1894), No. 6, pp. 403–434*).

Tuberculosis in domestic animals, G. SCHNEIDEMÜHL (*Fühling's landw. Ztg., 43 (1894), No. 13, pp. 397–405*).—A discussion of means of dissemination, diagnosis, and prevention.

The Koch test for tuberculosis, H. P. ARMSBY (*Pennsylvania Sta. Rpt. 1892, pp. 94–97*).—A reprint from Bulletin 21 of the station (E. S. R., 4, p. 359).

Report of the special committee on abortion in cattle, J. H. THOROLD (*Jour. Roy. Agr. Soc. England, ser. 3, 5 (1894) No. 18, pp. 312–317*).—A brief history of the disease, summary of breeders' evidence, and recommendations.

Spaying cows, W. J. S. MCKAY (*Agl. Gaz. N. S. W., 5 (1894), No. 5, pp. 334–344, figs. 12*).—An account of implements, stanchions, methods of operating, and results of spaying 42 head of cattle.

Tuberculosis, L. PEARSON (*Pennsylvania Sta. Rpt. 1892, pp. 98–107*).—A reprint from Bulletin 21 of the station (E. S. R., 4, p. 359).

Typhoid fever, H. L. BOLLEY, *North Dakota Sta. Bul. 13, Apr., 1894, pp. 27–31, fig. 1*).—A general discussion of typhoid fever, of the organism producing it, and of the precautions necessary to prevent the spread of the disease.

DAIRYING.

The investigations of J. Lehmann on the casein of human milk and cows' milk, W. HEMPEL (*Pflüger's Arch. Physiol., 56, No. 10, 11, and 12, pp. 558–578*).—The late Prof. Julius Lehmann, of Dresden, devoted the last years of his life to the study of the chemical nature of

milk and the means of treating cows' milk so as to make it resemble human milk more closely as a food. These investigations are the subject of the present paper.

Lehmann's method of determining casein was by means of unglazed porcelain plates, and was briefly as follows: The plate was wet with water and then 10 cc. of a mixture of equal parts of milk and water placed in the center. The serum separated in about an hour and a half, when the mixture of fat and casein was removed with a spatula and finally by setting the plate in water to free the last traces. This was placed on a weighed filter and washed with ether, the last traces of fat being removed by rubbing the casein in a glass mortar and then washing with ether. The casein was dried and then incinerated for ash. The determinations of fat and casein by this method are said to be very accurate. With practice 6 determinations can be made in a day. The casein is obtained in a natural, undecomposed condition, and is termed by Lehmann "genuine" casein for this reason.

As a result of numerous determinations it was found that the "genuine" casein of cows' milk contained, on an average, 7.2 per cent of ash, and that the ash contained:

CaO,	49.8 per cent,	equivalent to 3.20 per cent in water-free casein.
MgO,	2.1 per cent,	equivalent to 0.10 per cent in water-free casein.
K_2O,	0.9 per cent,	equivalent to 0.06 per cent in water-free casein.
Na_2O,	0.4 per cent,	equivalent to 0.03 per cent in water-free casein.
P_2O_5,	45.0 per cent,	equivalent to 2.92 per cent in water-free casein.
SO_3,	1.2 per cent,	equivalent to 0.08 per cent in water-free casein.

The indications were that the phosphorus in casein is all in the form of an ester-like compound derived from phosphoric acid, and that casein is to be regarded as a double compound of casein-calcium with calcium phosphate. From 1.45 to 1.75 per cent of CaO was found to be combined directly with the casein. The relation of casein-calcium to calcium phosphate in one series of experiments agreed with the formula $Ca_3(PO_4)_2$.Ca-casein; but in other cases the proportion of calcium phosphate was too small for this.

The average elementary composition of "genuine" casein was found to be: Ash, 6.47 per cent (mostly as calcium phosphate); carbon, 50.86; hydrogen, 6.72; nitrogen, 14.63; phosphorus, 0.81, and sulphur, 0.72; or calculated to ash-free casein, carbon, 54 per cent; hydrogen, 7.04; nitrogen, 15.6; phosphorus, 0.847; and sulphur 0.771.

Casein from cows' milk and from human milk differed widely in respect to sulphur and calcium phosphate, "showing that they are undoubtedly two different caseins." While "genuine" casein from cows' milk contained 0.723 per cent of sulphur and 6.6 per cent of calcium phosphate, "genuine" casein from human milk contained 1.09 per cent of sulphur but only 3.2 per cent of calcium phosphate.

The average composition given by Lehmann for cows' milk and human milk is as follows;

Average composition of cows' milk and human milk.

	Cows' milk.	Human milk.
	Per cent.	*Per cent.*
Water	88.0	88.5
Casein	3.0	1.2
Albumen	0.3	0.5
Fat	3.5	3.8
Milk sugar	4.5	6.0
Ash	0.7	0.2
	100.0	100.0

The figures for human milk are believed to be especially reliable, as the milk was obtained by entirely emptying the glands.

The casein precipitated from human milk and cows' milk by acids also differed in amount, there being in human milk 1 part (by weight) of casein to 3 of fat, and in cows' milk 1 part to 1.16 of fat. The character of the casein precipitates was also very different.

In order to make cows' milk approximately like human milk, Lehmann recommends to dilute cows' milk until it has the proper percentage of casein, and then add sufficient cream, milk, sugar, and egg albumen to make the fat, sugar, and albumen content the same as human milk. In adding the albumen he recommends to beat the albumen from a hen's egg slightly, add 4 teaspoonfuls of water, and strain through a cloth, using the third portion for adding to the milk. This artificial human milk has been found to give good results in practice.

The fat of human milk, W. G. RUPPEL (*Ztschr. Biol.*, *31*, *No. 1*, *pp. 1–11*).—A butter was made from human milk which resembled cows' butter in general appearance. By fractional distillation the following substances were detected in the fat: Butyric, capric, caproic, myristic, palmitic, stearic, and oleic acids, and glycerin, and the presence of formic acid was indicated. These were not determined quantitatively, but the volatile fatty acids were found to be comparatively low, and the non-volatile acids to consist about half of oleic acid, while in the solid acids myristic and palmitic acids predominated over stearic acid. The presence of other acids besides those found is suggested.

[For the composition of the fat of cows' butter see E. S. R., 4, p. 213.]

New method of souring cream for butter-making (*Milch Ztg.*, *23* (*1894*), *No. 19*, *p. 301*).—The German Government has recently granted a patent on a method for souring cream without the aid of fermentation. The cream as soon as raised is placed in the churn and sufficient dilute hydrochloric acid added to give the cream the desired acidity, the same degree of acidity being used as where the cream is ripened. The cream is then churned. It is claimed that the hydrochloric acid takes the place of the acid developed in fermentation, and has no undesirable effect on either the cream, butter, or buttermilk. What the function of the hydrochloric acid is, or in what respect the method is an improvement over churning the cream sweet, the patentee does not

explain. The method is to be tested in dairy experiments at an exhibition of the German Agricultural Society at Berlin.

On the change in the composition of butter by long keeping, A. H. ALLEN and C. G. MOOR (*Analyst, 19 (1894), June, pp. 128–131*).—Four samples of Danish butter which had been kept in sealed tin cans since 1888 were analyzed and the results compared with the analyses of the same lots of butter when fresh, as follows:

Composition of butter when fresh and after keeping over 5 years.

	Butter marked "B."					Butter marked "O."		
	Analyzed November, 1888.		Analyzed March, 1894.			Analyzed November, 1888.		Analyzed March, 1894,
	Copenhagen.	London.	London.1.	London.2.	London.3.	Copenhagen.	London	London.
Condition of butter	Fresh.	Fresh.	Decomposed.	Decomposed.	Decomposed.	Fresh.	Fresh.	Not decomposed.
Specific gravity at 100° C	0.8639	0.8640	0.8634	0.8696	0.8730	0.8641	0.8641	....
Volatile fatty acids, by Reichert-Wollny method[1]	22.63	22.39	14.43	12.02	12.02	24.39	24.70	22.48
Percentage of KOH required for saponification	22.27	22.05	21.99	22.55	22.88	22.15	22.03	23.33
Saponification equivalent	251.90	254.40	255.10	248.70	245.20	253.30	254.60	240.40
Soluble fatty acids, per cent	....	4.37 4.50 4.45	3.82	5.66	5.80	....	4.60 4.66 4.77	5.89
Insoluble fatty acids, per cent	....	90.24 90.62	90.73	90.70	90.06	....	89.90 90.30	85.78

[1] Cubic centimeter decinormal alkali required for 5 gm. of butter.

In commenting upon the results, Mr. Allen said that the figures were no doubt surprising and he could not offer any definite explanation. In the samples of "B" the volatile fatty acids had diminished from 22 to 12, while in the sample "O" they had diminished from 24.7 to 22.48. On the other hand, the soluble fatty acids decreased only in the case of 1 can, although the 3 cans were kept side by side. He believed the figures indicated that it was impossible to tell from such data, without going into the differentiation of the nature of the volatile acids, what change had occurred. The samples "B" and "O" had behaved in a different manner, although they had been kept under the same conditions as to exposure, absence of light, etc.

The behavior of cholera bacilli in milk and cheese, H. WEIGMANN and G. ZIRN (*Landw. Wochenbl. Schles. Holst., 1894, No. 19, pp. 298, 299; and Milch Ztg., 23 (1894), No. 20, pp. 311–313*).—Cholera bacilli from a person who had died of cholera in Hamburg were inoculated into sterilized milk, and in a few days increased enormously. In 5 experiments whole milk or skim milk was strongly inoculated with this cholera culture, and then mixed with more milk and used for making Limburger cheese. In most cases the bacilli were dead within 9 hours after adding the rennet, and in no case, even when they were added in very large quantities, did they retain their virulence more than 24 hours. Experiments in which 50 cc. of milk was mixed with 0.2, 1, and 5 cc. of cholera culture, respectively, bore out the author's suspicion that the loss of virulence of cholera bacilli in milk was dependent, not

alone upon the increasing acidity of the milk, but upon the relative number of the bacilli in proportion to other milk bacteria. The larger the proportion of cholera bacilli the longer they retained their virulence. The conclusion from these experiments is that there is no ground for regarding as especially dangerous the cheese made in a cholera-infected district, or for compelling cheese factories in such districts to close.

Swedish butter exhibitions (*Tidskr. Landtmän, 15 (1894), pp. 379, 380, 399*).—The ninth in a series of butter exhibitions at Gothenburg (Sweden) was held April 23 last. Sixty-two butter factories exhibited. Out of a possible score of 12 the average score was 11.3 points; the dairy butter scored 11.3 points on an average, the proprietary creamery butter 11.6 points, and the coöperative creamery butter 11.1 points. The average water content of the butter exhibited was 13.62 per cent, ranging from 9.13 per cent to 16.57 per cent. Eighty-two per cent of the samples exhibited contained between 11 and 15 per cent of water.

The twenty-third butter exhibition at Malmo (Sweden) took place on May 7 last. Fifty factories exhibited. The average score was 11.6 points; private dairy butter 11.5 on an average, proprietary creamery butter 11.3, and coöperative creamery butter 11.8 points. Average water content for all samples 13.82 per cent, the analyses ranging from 11.65 to 16.38 per cent. Eighty-two per cent of the samples had between 11 and 15 per cent of water.—F. W. WOLL.

Process for preserving milk and cream for a length of time, rendering it suitable for lengthy transit, W. F. E. CASSE (*Jour. Soc. Chem. Ind., 13 (1894), No. 5, p. 537*).—A process patented in England for preserving milk by adding frozen milk and packing in sawdust. Milk is said to be kept fresh 2 or 3 weeks by this means.

Variations in the "latent period" of coagulation of milk treated with rennet, C. PAGÈS (*Compt. Rend., 118 (1894), No. 23, pp. 1291–1294*).—The latent period of coagulation is defined as the period which elapses between the addition of the rennet and the curdling of the liquid.

Some observations on the working of the Cooley system and the De Laval separator system in coöperative creameries (*Connecticut State Sta. Rpt. 1893, pp. 145–170*).—This is a reprint from part III of the Annual Report of the station for 1893 (E. S. R., 5, p. 998).

Dairying in Ontario (*Ontario Dept. of Agr. Special Bulletin, 1894, May 1, p. 23*).—This is devoted to statistics of the dairy industry of Ontario, description and plan of a separator creamery, and text of the laws under which dairy companies may be incorporated.

Dairy bulletin (*Ontario Agl. College Bul. 93, pp. 20*).—A popular bulletin on milk-testing, separator creameries, cream-gathering creameries, and the making of spring cheese, summer cheese, and fall cheese.

Tests of dairy apparatus, H. P. ARMSBY, H. J. WATERS, and W. H. CALDWELL (*Pennsylvania Sta. Rpt. 1892, pp. 51–64, figs. 4*).—A reprint of Bulletin 20 of the station (E. S. R., 4, p. 364).

Tests of centrifugal separators, W. H. CALDWELL (*Pennsylvania Sta. Rpt. 1892, pp. 64–79, figs. 3*).—A reprint of Bulletin 22 of the station (E. S. R., 4, p. 751).

Care of milk for cheese factories and creameries, H. H. DEAN (*Ontario Agl. College Bul. 94, pp. 8*).—A popular bulletin.

The quality of cheese resulting from feeding plants fertilized with chemical fertilizers, C. BESANO (*Annuario R. Staz. Sper. Caseificio in Lodi, 1893, pp. 58–81*).—Replies to a circular letter on this subject addressed to dairymen and dealers, correspondents differing widely in their reports.

TECHNOLOGY.

Concerning the crystallization of "massecuite" in motion (*Jour. Assn. A. Élèv. Gembloux.* 4 (1894), No. 2, pp. 346-352).—A discussion of methods of sugar-making.

Utilization of wine marc, A. MÜNTZ (*Compt. Rend.*, 118 (1894), No. 22, pp. 1224-1226).—A method of obtaining the wine left after pressure, by means of displacement with water, is described, and the value as cattle food of the residue is discussed.

The action of certain antiseptics on alcoholic fermentation and on diseases of wines, F. RAVIZZA (*Staz. Sper. Agr. Ital.*, 26 (1894), No. 4, pp. 357-386).

Studies on alcoholic fermentation, N. VON CHUDIAKOW (*Landw. Jahrb.*, 23 (1894), No. 2 and 3, pp. 391-534, pls. 5, figs. 2).

The influence of fluorin compounds on beer ferments, J. EFFRONT (*Compt. Rend.*, 118 (1894), No. 25, pp. 1420-1423).

The Tannins, Vol. II, H. TRIMBLE (*Philadelphia: J. B. Lippincott, 1894*).

Improvements in the manufacture of sulphuric acid, P. S. GILCHRIST (*Jour. Amer. Chem. Soc.*, 16 (1894), No. 7, pp. 498-500, fig. 1).—A report of results of applications of improved Hacker and Gilchrist pipe-columns at Darlington, S. C.

AGRICULTURAL ENGINEERING.

Information regarding roads, road materials, and freight rates in the United States (*U. S. Dept. Agr., Office of Road Inquiry, Buls. 4, pp. 11; 5, pp. 24, maps 4; 6, pp. 30, maps 7; and 7, pp. 29, maps 5*).—Bulletin 4 is a report on road-making materials in Arkansas, by J. C. Branner, State geologist. Bulletin 5 is a report by R. Stone on road materials and transportation rates in certain States west of the Mississippi, prepared from data furnished by officials of various railway companies. Bulletin 6, by the same author, gives information on roads, road materials, and freight rates in certain States north of the Ohio River, obtained in the same manner. Bulletin 7 is a report, by the same author, on roads and road-making materials in certain Eastern and Southern States, compiled from the same sources.

Earth roads, hints on their construction and repair, R. STONE (*U. S. Dept. Agr., Office of Road Inquiry, Bul. 8, pp. 20, figs. 11*).—Information and suggestions regarding the construction of roads without gravel or stone, and the repair of such roads.

Irrigation and the storage of water for agricultural purposes, J. DARBY (*Jour. Roy. Agr. Soc. England, ser. 3, 5 (1894), No. 18, pp. 272-289*).—A brief note on irrigation on the continent of Europe, and descriptions of irrigated meadows and of storage tanks in England.

Subirrigation in greenhouses, F. W. CARD (*Gard. and Forest, 7 (1894), p. 268*).

The conservation of water for orchards, I. P. ROBERTS (*Can. Hort., 17 (1894), No. 7, pp. 234-236*).

STATISTICS.

Danish agricultural exports and imports, 1892-'93, F. RECK (*Tidsskr. Landökon.*, 13 (1894), pp. 170-188).—The article contains summaries and discussions of Danish agricultural exports and imports during 1892-'93, as well as comparisons between statistical data for this and previous years. The following table shows the excess of exports over imports for 1892-'93, and the averages for the preceding 10 years:

Excess of exports of Danish agricultural products over imports.

	1892–'93.	Average. 1882–'92.		1892–'93.	Average. 1882–'92.
Horses ....number..	5,017	8,224	Eggs ....million doz..	9.75	7.82
Steers and cows ....do....	75,657	88,017	Wool..........million lbs..	—1.23	0.38
Calves ....do....	2,028	7,115	Cereals ....million bu..	—4.14	—4.90
Sheep and goats ....do....	1,521	49,677	Bran .... million lbs..	—194.41	—179.49
Swine.....................do....	53,992	179,592	Oil cakes................do....	—150.55	—106.37
Meat ....million lbs..	10.53	0.26	Rape and linseed.......bu..	—56,924	—41,374
Pork.......................do....	84.14	45.82	Artificial fertilizers, million lbs	—50.72	—36.65
Butter.....................do....	78.97	49.36	Manures ....lbs..	—17.24	—10.11
Cheese....................do....	—1.65	—1.12			

The main interest is attached to the exports of butter and pork, these being the two most important agricultural export articles for Denmark. The quantity of butter exported during 1892–'93 was 105.43 million pounds (avoirdupois), against 63.66 during 1882–'92, and 100.22 in 1891–'92. The imports of butter during the same years were as follows: 1892–'93, 26.48 million pounds; 1882–'92, 14.29; and 1891–'92, 24.26; or the excess exports of butter during the periods mentioned were 78.96, 49.37, and 75.96 million pounds (avoirdupois), respectively. The excess exports of butter during 1882–'83 were 29.32 million pounds. The butter exports over and above imports have thus almost trebled during the last 10 years.

Of the 105 million pounds of butter exported during 1892–'93 nearly 102 million pounds went to England. Sweden and Denmark supply more than one half, and Denmark alone two fifths, of the butter imported into England.

The average price for the year paid for first-class Danish butter was 32.1 cts. per pound (Danish) during 1893, against 33.5 cts. during 1892 (=29.2 cts. and 30.5 cts. per pound avoirdupois, respectively).

The total excess exports of pork from Denmark during 1893 amounted to 84.14 million pounds, or an increase of 5.63 million pounds above the excess during the preceding year. The report states that with higher prices for pork and lower prices for grain feeds, hog raising has been very profitable during the past year and was doubtless the most remunerative line of animal husbandry in Denmark. (See also *Landmandsblade, 27, pp. 293–295*).—F. W. WOLL.

Swedish agricultural imports and exports during 1892, H. NATHORST (*Tidskr. Landtmän, 15* (*1894*), *pp. 180–182, 199–202, 238–240*).—A detailed account is given of imports and exports of Sweden during 1892, and more especially those touching upon agriculture. Some of these data are given below:

Swedish imports and exports.

	Exports.	Imports.		Exports.	Imports.
Horses ....number..	2,866	904	Pork and lard.........kg..	6,725,971	8,083,253
Cattle ....do....	19,275	794	Sausage ....do....	79,084	13,845
Sheep..................do....	19,005	407	Eggs..............million..	15.75	5.21
Hogs. ....kg..	396,555	38,566	Cheese ....kg..	188,018	191,442
Poultry ....number..	15,295	1,962	Butter ....do....	17,129,581	833,586
Meat ....kg.	339,100	796,754	Artificial butter ....do....	22,744	714,185

Value of excess exports of living animals	$1,128,000
Value of excess imports of meat, pork, and eggs............	347,914
Value of exports of dairy products..........................	9,029,486

Up to 1870 Sweden was a grain-exporting country, but since the beginning of the "eighties" it has imported large quantities of cereals. In 1892 the following quantities were imported: Wheat, 118.19 million kilograms; rye, 75.81; barley, 9.43; Indian corn, 18.36, and oats, 1.44. In 1892 the value of the excess imports of cereals amounted to over $7,236,000.—F. W. WOLL.

Production of butter in Norway (*Norsk Landmandsblad, 13 (1894), p. 165*).—During the past 6 years the production of butter in Norway has greatly increased, as will be seen from the following official data of exports and imports from 1888 to date:

Imports and exports of butter in Norway.

	Imports.	Exports.		Imports.	Exports.
	Kilograms.	*Kilograms.*		*Kilograms.*	*Kilograms.*
1888	2,387,140	292,560	1891	1,631,926	348,755
1889	2,338,060	257,870	1892	1,245,702	488,134
1890	2,451,030	211,100	1893	816,828	653,178

Judging from this increase in production it is very likely that Norway will, during the present year, or at any rate during the coming year, export more butter than is imported.

Report of the statistician (*U. S. Dept. Agr., Division of Statistics, Rpt. 116, n. ser., pp. 296–394*).—Crop report for June, tariff rates on principal cereals, compiled notes on foreign agriculture, notes from U. S. consular officers, the climate of Mexico, Mexican railways, and transportation rates.

An elementary text-book on the agriculture of the southern part of France (*Traite d'agriculture a l'usage du midi de la France*), B. CHAUZIT and J. B. CHAPELLE (*Montpellier and Paris: 1893, pp. 356*).—The subjects briefly treated are soils, manures, drainage, irrigation, methods of cultivation, field crops, vegetables, fruit and forest trees, viticulture, agricultural technology, domestic animals, and farm management.

Advantages in agricultural production, W. E. BEAR (*Jour. Roy. Agr. Soc. England, ser. 3, 5 (1894), No. 18, pp. 250–265*).

Organization of Montana Station (*Montana Sta. Bul. 1, pp. 16*).—This is an announcement of the organization of the Montana Station, with a description of the duties of the several departments.

Twelfth Annual Report of Ohio Station (*Ohio Sta. Bul. 52, pp. 44*).—This includes brief reports by the director, agriculturist, horticulturist, entomologist, and chemist, and the treasurer's report for the fiscal year ending June 30, 1893.

Reports of director and treasurer of Pennsylvania Station (*Pennsylvania Sta. Rpt. 1892, pp. 10–14*).—A brief review of work, a list of bulletins for the year, and a financial report for the fiscal year ending June 30, 1892.

NOTES.

Connecticut Storrs College.—Prof. A. G. Gulley, of the University of Vermont, succeeds Prof. H. E. Woodbury as teacher of horticulture at Storrs Agricultural College.

Georgia Station.—The success of the station butter and cheese dairy has induced special efforts on the part of the station to encourage the establishment of creameries and cheese factories in Georgia. One creamery and cheese factory has been established and is in successful operation. It is now proposed to organize a State dairymen's association in Georgia, and the effort is meeting with the hearty approval and encouragement of dairymen throughout the State.

Idaho Station.—A survey of the farm at the substation at Grangeville has been made by J. E. Ostrander, civil engineer of the station, and 100 $\frac{1}{20}$-acre plats for experimental work laid out. Experiments in grain growing will be commenced in the fall, and a study of the methods of hay-making will be carried on next summer in the meadows at Grangeville and in the laboratories at the university.

Louisiana Stations.—On July 1 A. Lehmann, chemist of the sugar station, resigned and his place has been filled by R. L. Bivins.

At the college and station at Baton Rouge the chairs of mineralogy and geology, and botany and mycology have been separated, Prof. W. W. Clendenin retaining the chair of mineralogy and geology, and Prof. W. R. Dodson being elected to the chair of botany, mycology, and bacteriology. This change was necessitated by the station undertaking to continue the geological and agricultural survey of the State. Prof. Clendenin's time will now be divided between the Agricultural and Mechanical College and field work on the survey for the station.

Michigan College and Station.—The college will in the future confer the degree of Master of Agriculture upon such of its graduates as have won distinction in any line of agricultural pursuit.

The station has installed an electric motor for use in grinding feed, cutting silage, operating dairy machinery, etc.

Nebraska Station.—Prof. G. D. Sweezey began work as meteorologist to the station July 1. G. A. Loveland has been made assistant meteorologist, although retaining his position with the Weather Bureau, which has been removed from Omaha to Lincoln.

New York Cornell Station.—E. G. Lodeman, assistant in horticulture, has gone to Europe on three months' leave of absence to study the question of spraying and other treatment of diseases of grapes in France and Italy.

The work of the station has been quite largely extended by an appropriation by the State of $8,000 for the purpose of horticultural experiments in the fruit belt. The work is under charge of Prof. Bailey and a corps of field assistants, and is being prosecuted vigorously. Particular attention is given to spraying and to manuring orchards.

Rhode Island Station.—G. M. Tucker has been appointed an assistant in the agricultural division, G. E. Adams and W. B. Madison assistants in the horticultural division, and C. L. Sargent second assistant in the chemical laboratory.

Utah Station.—J. H. Paul has been elected director and H. E. Hatch treasurer of the station.

Wisconsin Station.—At its June meeting the board of regents of the University of Wisconsin elected E. H. Farrington, chemist of the Illinois Station, to the

chair of associate professor of dairy husbandry in the college. Prof. Farrington will have his office in the dairy building at the university, and have under his care the management of the dairy school instruction, together with such investigation as will naturally fall to him. The building of the dairy school, hitherto in use only during the sessions of the school, will now be used as a practical creamery throughout the year, purchasing milk from farmers, and making fancy print and tub butter, Cheddar cheese, and pasteurized cream.

Prof. H. L. Bolley, botanist of the North Dakota Station, will spend two months at the college with Prof. H. L. Russell, devoting his time to the bacteriology of the dairy.

In March and April the dairy herd at the university farm was examined through the Koch tuberculin test by Drs. Russell and Clark, to note the possible presence of tuberculosis in the herd. Twenty-five animals responded to the test. Twenty-eight have been killed, of which number 26 were found diseased. The tuberculin test properly diagnosed every case but one with all the animals slaughtered. The lymph used was that from the Koch laboratory and this Department. The Department lymph was found very satisfactory.

WASHINGTON STATION.—J. A. Balmer assumed the duties of horticulturist June 1, and W. J. Spillman those of agriculturist July 1.

WYOMING STATION.—F. J. Niswander, entomologist of the station, has resigned. The work in economic entomology will be carried by the horticulturist, B. C. Buffum.

AUDUBON SUGAR SCHOOL.—So great has become the growth of the sugar school that the board of trustees at its last session ordered the erection of a new chemical laboratory, capable of accommodating 50 boys. This laboratory is now in process of erection.

TECHNICAL EDUCATION IN DAIRYING—AN ENGLISH EXAMPLE.—Under this title Richard P. Ward, organizing secretary to the Cheshire County Council, describes in *Transactions of the Highland and Agricultural Society of Scotland (1894, p. 312)* the Cheshire scheme of instruction in dairying. This consists of lectures given in villages, practical instruction in cheese-making and butter-making given to classes at farmhouses in different places throughout the country, and a permanent dairy institute. The latter is located on a farm of 170 acres at Worleston, near Crewe. It provides regular, continuous, and systematic practical instruction in both cheese and butter making, as well as in the theoretical principles involved. The 6 months from April to October are devoted entirely to female students and the other 6 months to males. Three sets of 10 scholarships, each tenable for 8 weeks, are granted during the summer months, and 2 sets of 10 scholarships, each tenable for 11 weeks, during the winter months. These scholarships cover the cost of fees and board and lodging. During 1893 the institutes gave instruction to 135 students. "The quality and value of the cheese made in the county has materially improved during the last 2 or 3 years. There can be no doubt that a great portion of this improvement is due to the technical instruction given by the county council and the greater care now being given to this important industry, through the special attention being called to it."

EXPERIMENT STATION RECORD.

VOL. VI. NO. 3.

The act of Congress making appropriations for the agricultural experiment stations for the fiscal year ending June 30, 1895, provides for the first time for supervision of the expenditures of the stations by United States authorities, in the following words:

> The Secretary of Agriculture shall prescribe the form of the annual financial statement required by section three of the said act of March second, eighteen hundred and eighty-seven; shall ascertain whether the expenditures under the appropriation hereby made are in accordance with the provisions of the said act, and shall make report thereon to Congress.

It will be observed that these provisions do not in any way infringe upon the autonomy of the stations. The administration of the funds is left, as before, wholly to the State authorities. Under the guidance of these authorities the stations are to be managed with "due regard to the varying conditions and needs of the respective States and Territories." The United States will not, however, as in the past, be content to allow the money appropriated from the national Treasury for agricultural investigations to be spent without any accounting to its own officers. The expenditures and the work of the stations are to be formally scrutinized by the Secretary of Agriculture, and a report of his examination is to be presented to Congress. This should enable Congress to take more intelligent action with reference to the just merits and needs of the stations, and at the same time it should strengthen the stations in the estimation of the country in so far as their work is efficiently and wisely done, while it should protect them against vague accusations of misusing public funds, which perhaps derive their force chiefly from the fact that no one can authoritatively deny them.

In this connection it is interesting to observe that M. Tisserand, in his most recent report on the experiment stations in France,[1] in his capacity as Director of Agriculture, protests against such centralization of management of the stations in that country in the Ministry of Agriculture as would involve their complete administration and maintenance by the general government. At present these stations are largely under the control of the local authorities in the districts (*départ-*

[1] Bul. Min. Agr. France, 1894, No. 3, p. 229.

ments) where they are located. The directors are chosen by a committee appointed under regulations prescribed by the Ministry of Agriculture, whose members must be capable of judging whether the candidates possess the necessary scientific attainments. An advisory committee of station officers aids the Ministry in determining whether the stations have properly discharged their duties and how the funds appropriated by the general government shall be divided among them. A member of this committee is selected each year to inspect the stations. The inspectors thus far appointed have been MM. Müntz and Grandeau. M. Tisserand holds that this system is more economical and gives better results than if the stations were wholly under the direction of the Ministry of Agriculture and derived all their funds from the national treasury. The single improvement in the conduct of the stations which he urges is that the directors be required to explain the work of the stations to assemblies of farmers two or three times a year, with a view to giving the farmers a better understanding of what the stations are doing and to enabling the stations to find out wherein their investigations fail to meet the needs of practical men.

The report of M. Tisserand above referred to, which presents in a very clear way the history and present organization of agricultural education and investigation in France, contains much that is of great interest. The wonderful development of institutions for instruction and research in agriculture under the Republic, and the complete way in which the needs of various classes of the rural population are provided for in the system now in operation, show the importance which has been attached to this matter by the leaders of public opinion in France during the past twenty-five years. Beginning with the thoroughly scientific course of instruction in the Institut Agronomique at Paris, agriculture in varying proportions of theory and practice is taught in schools of all grades down to the primary. To provide for the education of teachers of agriculture for the lower schools, as well as to keep the adult farmers acquainted with the progress of their art, 116 professors (or lecturers) of agriculture are now at work in the different districts. In 1893 those professors gave instruction to 2,600 or 2,700 students in the normal schools and to more than 300,000 persons who attended their *conférences*. But perhaps the most striking feature of this vast system of agricultural education are the model fields (*champs de démonstration*), of which there are now more than 3,000 in France. "The results obtained," says M. Tisserand, "are remarkable. The model fields, by showing at all points of our territory to the eyes of the farmers the results that may be obtained by the application of certain fertilizers, by certain methods of culture, by certain varieties of plants, etc., have been the cause of important improvements; and there is only a beginning. . . . It can be said without fear that the model fields have been one of the powerful factors in increasing our agricultural production.'

In studying the system of agricultural investigation and education in France as portrayed by M. Tisserand, one is deeply impressed with the clear distinctions which have been drawn between the institutions for research and instruction. In France the experiment station is an institution for the discovery of new truth. Even the scientific work required in the analysis of soils, fertilizers, and feeding stuffs, or other work required for the protection of the farmers against fraud, is largely done in separate institutions designated agricultural laboratories. The stations are to find out what is now unknown, and their methods are strictly scientific. When they have discovered and announced to the world a new principle or a new application of well-known principles which will benefit agriculture their duty is fulfilled. It then remains for the teachers of agriculture to explain this new truth to their students and hearers, for the press to disseminate it, and for the model field to make of it an object lesson which may be copied by the practical farmer. No doubt there are many advantages in this thorough classification of institutions for the advancement of agriculture. The workers in each can concentrate their efforts on their duties, whether they be of research or instruction, and there is a better opportunity for the scientist to make thorough work of his investigations and for the teacher or model farmer to consider the needs of his pupils and to adapt his methods of instruction to their requirements. In France it would appear that somewhat more of sympathy between the scientist and the farmer is desirable; in the United States the scientist should be allowed to pursue his proper work without so much interruption to answer questions which it should be the business of the schoolmaster or the lecturer to explain to the farmer.

CONVENTION OF ASSOCIATION OF OFFICIAL AGRICULTURAL CHEMISTS, 1894.

The eleventh annual convention of the Association of Official Agricultural Chemists was held in the lecture room of the National Museum at Washington, D. C., August 23–25. The first day's session was presided over by Vice-President H. A. Huston, the president, E. B. Voorhees, being unavoidably detained until the second day. About 60 chemists were in attendance.

In the president's address the history of the Association was briefly reviewed. Its relations especially to the fertilizer industry were discussed; and the broadening of lines of investigation, more thorough study of methods, particularly those for estimating the availability of fertilizing constituents, and coöperation with foreign chemists were urged. It was also urged that in the publication of fertilizer work the practical application of the results should be more clearly brought out.

Several new and important features were inaugurated at this session of the Association. All proposed changes in methods were referred to a committee, composed of the reporters for the year, before being acted upon by the Association. The advantages of this method of procedure were apparent in the economy of time in the general sessions, more intelligent action on the part of the Association, and greater conservatism. Another desirable action was the recommendation to the president of the Association that he continue the reporters in office for at least two years, and the appointing of associate reporters. It was believed that two years would give each reporter better opportunity to develop his plan of work and carry it into effect than one year, enabling him to profit the second year by his experience the first year. The associate reporters are to assist in carrying out the work planned by the reporters, and may succeed the latter.

The constitution was also amended to provide that no changes in official methods of fertilizer analysis shall be made, except by unanimous consent, until an opportunity shall have been given to all official chemists exercising official fertilizer control to test the proposed changes.

The scope of work of the Association was widened to include investigations of methods employed in the tanning industry, and a reporter on tannin was provided for.

A committee on revising and editing the methods of analysis, consisting of L. L. Van Slyke, R. J. J. De Roode, and W. D. Bigelow, was appointed.

On invitation, the Assistant Secretary of Agriculture appeared before the convention and delivered a brief address.

Fertilizers.—(1) *Potash.*—The report on potash was presented by H. J. Wheeler. The work of the year on this subject consisted principally of tests of errors due to impurities in reagents and to double decomposition of potassium-platinum chlorid due to the ammonium chlorid wash used in the Lindo-Gladding method. The following changes in the methods for potash were adopted:

In the alternate method the time of boiling in preparing the solution was increased to 30 minutes and the number of cubic centimeters of water used to 300, to conform with directions for the same operation under the Lindo-Gladding method; the directions for preparing solutions of organic substances containing potash were slightly modified to make them more explicit, and the use of ether in washing the potassium-platinum chlorid obtained in the alternate method was dispensed with. It was finally recommended that the reporter for next year continue the lines of investigation pursued during the past year, and in addition make comparative tests of the methods in the presence of maximum amounts of sulphates, and to investigate the value of adding calcium chlorid to remove soluble phosphates in the determination of potash in superphosphates by the Lindo-Gladding method, as proposed by H. A. Huston.

(2) *Phosphoric acid.*—The report on phosphoric acid was submitted by B. W. Kilgore. The subjects of investigation during the year were (1) Ross' method of direct determination of citrate soluble phosphoric acid;[1] (2) treatment of the residue from the citrate solution with a mixture of nitric and hydrochloric acids instead of igniting; (3) determination of phosphoric acid by titrating the yellow precipitate of ammonium phosphomolybdate;[2] and (4) methods of washing the precipitate with magnesia mixture.

After discussion of the report and the reading of special papers on the subject of phosphoric acid, the following changes in official methods were adopted: In the preparation of the solution of the residue from digestion with citrate solution it is made optional whether the residue is ignited and dissolved in hydrochloric acid or returned to the digestion flask and treated with a solution of from 30 to 35 cc. of nitric acid and from 5 to 10 cc. of hydrochloric acid; and in the directions for the preparation of dilute ammonia for washing it is specified simply that the solution shall contain $2\frac{1}{2}$ per cent of ammonia, the wording in other parts of the method being made to conform to this change. In view of the contradictory results with the Ross method of direct determination of citrate-soluble phosphoric acid, it was recommended that it be subjected to further trial before being passed upon by the association.

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[1] U. S. Dept. Agr., Div. of Chem. Bul. 38, p. 16; or Jour. Am. Chem. Soc., 16 (1894), No. 5, p. 304.

[2] Jour. Am. Chem. Soc., 15 (1893), No. 7, p. 382; 16 (1894), No. 4, p. 278.

In this connection B. B. Ross called attention to a new reaction between ammonium phosphomolybdate, sulphuric acid, and hydrogen peroxid, which he suggested might be utilized in the volumetric determination of phosphoric acid.

In a paper on "The estimation of phosphoric acid by titration of the yellow precipitate of ammonium phosphomolybdate," B. W. Kilgore reviewed the literature of this method, and reported results of comparisons of Pemberton's method with the official method. The results by the former method were generally too high, due, as the experiments indicate, to the separation of a mixture of molybdic acid and molybdate of ammonia at the temperature prescribed. By reducing the temperature to 60° C. in the bath, corresponding to 55° in the flask, results closely agreeing with those given by the gravimetric method were obtained. It was also found that the official molybdate solution was less liable to form a deposit than the aqueous solution recommended by Pemberton. By using 25 cc. of the official solution for each 0.2 gm. of substance and reducing the temperature of the bath to 60° the author obtained fairly concordant results which agreed well with those obtained by the gravimetric method.

A paper on "A comparison of results by old and new methods for citrate-soluble phosphoric acid," by B. W. Kilgore and C. B. Williams, was read, in which attention was called to the fact that changes in the manipulation of the official method made at the last meeting involve an increase in actual temperature of digestion of about 2° C.; and results of 17 tests are reported which show that this increase in temperature causes an average decrease of 0.5 per cent of insoluble phosphoric acid.

A paper on "A comparison of Pemberton's method of phosphoric acid determination with the official method," by F. Bergami, was presented to the convention. In this it was shown by the results of comparative trials on 15 materials that the Pemberton method gave results a little lower than those obtained by the official method. It is suggested that the results by the official method would probably be somewhat reduced if special precautions were taken to neutralize the ammonia solution of the phospho-molybdate precipitate. The results on the whole are thought to be generally favorable to the Pemberton method on the score of rapidity and accuracy. It was observed in connection with this investigation that the presence of a small amount of carbonic acid in the standard alkali did not affect the accuracy of the determinations.

A mechanical shaker for precipitating solutions of phosphate was described by H. A. Huston.

In a paper on "The determination of phosphoric acid by molybdic solution," W. E. Garrigues reported results of investigations on the effect of evaporating phosphoric acid solutions to dryness to remove silica upon the subsequent determination of phosphoric acid. It was found that both meta and pyrophosphoric acid were formed in this case

and were afterwards incompletely reconverted into orthophosphoric acid. His investigations indicate further that for amounts of phosphoric acid exceeding 0.1 gm. a greater proportion of molybdic solution than 50 cc. to 0.1 (the proportion prescribed in the official methods) must be used to insure prompt and complete precipitation of the phosphoric acid in 1 hour. The Pemberton method in the hands of the author gave results agreeing well with the official method, although a little higher, due, it is believed, to incomplete precipitation in the latter. The results obtained also indicate that it is immaterial whether there is considerable or only a slight excess of ammonia at the time of precipitation. A method is described which it is believed largely overcomes the above objection.

(3) *Nitrogen.*—A report on the study of methods of determining nitrogen, especially those applicable to substances containing nitrates, was submitted by J. M. Bartlett. The changes proposed and adopted were principally of a verbal character. In the directions for the preparation of standard solutions the word "alkali" was substituted for "ammonia," and the wording in the different methods was changed to conform to this modification. The amount of material taken for digestion in the Kjeldahl and Gunning methods and their modifications was directed to be uniformly stated as from 0.7 to 3.5 gm. Fassbender's method was recommended for trial during the coming year, and the Schulz-Tiemann method for nitric nitrogen was adopted as provisional. The Fassbender method is essentially as follows: To 1 gm. of substance 0.7 gm. of mercuric oxid and 20 cc. of concentrated sulphuric acid are added and digestion conducted as usual, bumping and frothing being checked by the addition of a piece of paraffin the size of a pea. The ammonia is set free by adding 60 cc. of a solution of caustic soda and potassium sulphid prepared by adding a solution of 350 gm. of potassium sulphid in 2 liters of water to 11.5 liters of soda solution of 1.375 sp. gr.

In a paper on "The determination of nitric nitrogen by the zinc-iron method," F. S. Shiver reported the following method, which had given in his hands practically theoretical results on pure nitrates, although its applicability to mixed fertilizers had been tested to only a limited extent: Five grams of nitrate were dissolved in 500 cc. of water and 50 cc. of this solution placed in a Kjeldahl digestion flask with 5 gm. each of zinc dust and iron filings; 75 cc. of water and 80 cc. of sodium hydrate, 1.3 sp. gr., were added and the flask connected with a condenser, to which was attached an Erlenmeyer flask containing the standard acid. The contents of the flask were thoroughly mixed and allowed to stand 1 hour, then heated gently, and finally boiled until 100 to 125 cc. were distilled over. Chlorids and sulphates did not impair the accuracy of the method. The averages of a number of determinations of nitrogen in nitrate of potash containing theoretically 13.88 per cent of nitrogen were by zinc-iron method 13.84, by modified

Kjeldahl method 13.83 per cent. On pure sodium nitrate the average by the zinc-iron method was 15.95 per cent, by the modified Kjeldahl method 15.88 per cent.

In a paper on "The standardization of normal acid and alkali solutions," by H. K. Miller, the results of a comparison of the leading processes were reported.

Soils and ash.—The report on this subject was presented by A. M. Peter. The results of comparative tests by different analysts showed that the great irregularities did not permit of computing averages or of drawing very definite conclusions. The recommendations of the reporter, which were adopted by the convention, provided for subjecting to analysis only that portion of the soil which passes a sieve having circular holes ½ mm. in diameter; for separating the soluble silica before ignition to determine the carbon; for the elimination of the error in carbon determination due to the water in hydrated silica, and for digestion for 10 hours under atmospheric pressure in a flask provided with a condenser to prevent evaporation of acid. Moisture is to be determined in the air-dry soil by drying to a constant weight in a water oven kept briskly boiling, and the acid-soluble materials are to be determined in this dry soil, the results being reported on the air-dry basis. In the method for the determination of sulphuric acid in soils,[1] the amount of distilled water added in the first case is reduced to 50 cc., the amount of barium chlorid added is reduced to 2 or 3 cc., and the amount of boiling water to be used in washing the barium-sulphate precipitate is reduced to 15 to 20 cc. A few other unimportant changes, principally of a verbal character, were recommended and adopted.

It was especially recommended that the reporter for next year investigate the chemical methods of determining the availability of potash and phosphoric acid in soils.

In connection with the discussion of the subject of soils, a paper "On the action of oxalic acid on phosphates, silicates, and soil," by J. H. Castle, P. Marvin, and J. C. Calvert, was read before the association. In this the results of treatment of several commercial phosphates of lime, silicates of calcium and potash, feldspar, and soil are reported, which show that comparatively large amounts of phosphoric acid and potash are dissolved out of these substances by this reagent, and indicate that oxalic acid is probably one of the strongest acids found in root sap. By heating 10 gm. of soil with 100 cc. of normal oxalic acid in a pressure bottle for 6 hours in a boiling water bath as much phosphoric acid was dissolved as by the provisional method of soil analysis, but slightly less of potash. It is believed that the amount of the latter might be increased by mixing a stronger acid with the oxalic acid. The advisability of using oxalates as a fertilizer, as indicated by these tests, is pointed out, and it is stated that this subject will be further investigated in pot experiments.

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[1] U. S. Dept. Agr., Div. of Chem. Bul. 38, p. 203.

In a paper entitled "A method for the determination of phosphoric acid in soils," A. Goss suggested the following modification of the Kjeldahl method as adapted to this purpose: Ten grams of air-dry soil, 0.7 gm. of mercuric oxid, and 20 to 30 cc. of concentrated sulphuric acid are boiled in a digestion flask for 1 hour; 100 cc. of water, 5 cc. of hydrochloric acid, and 2 cc. of nitric acid are added, and the whole boiled gently for 2 minutes. The solution is made up to 250 cc. and 100 cc. taken for precipitation; 75 cc. of molybdic solution is then added, and the contents of the flask kept at 80° C. for 15 minutes, shaking 4 or 5 times. After standing 10 minutes the solution is filtered, with gentle suction. The method is then proceeded with as usual, observing certain minor precautions which are enumerated. Experimental data upon which the various provisions of this method rest are given in detail.

In "A note on the direct determination of potash in the soil solution," A. M. Peter reports the results of direct evaporation of an aliquot part of the hydrochloric-acid solution with an excess of platinic chlorid, which agree closely with those obtained by the provisional method.

Sugar.—A brief report on sugar was presented by G. L. Spencer. The work of the year related to the determination of moisture (1) by the official method,[1] (2) by drying in a vacuum for 5, 15, 20, and 40 hours, and (3) by the paper coil or Jossé method. Three Association chemists and two refinery chemists took part in this work. The results indicated that the official method is fully equal, if not superior, to the other methods tested, and rendered inadvisable recommendations of any modification of present methods of analysis. Further investigation of methods of moisture determination during the coming year was recommended.

A paper "On the determination of cane sugar in the presence of commercial glucose," by H. A. Weber and Wm. McPherson, was presented. The authors reported an investigation of methods of acid reversion of sucrose in the presence of dextrin and glucose, and the subsequent determination of the invert sugar by means of Fehling's solution or the polariscope. The results show a slight error in these methods, due to hydration of dextrin, which may be reduced to a minimum by heating for 10 minutes, gradually bringing the temperature to 68° C. at the end of that time. It was also found that acetic acid inverts glucose completely, and that where Fehling's solution is used for determining sucrose in presence of commercial glucose it is preferable to hydrochloric acid for inversion.

Fermented and distilled liquors.—The reporter on the subject of fermented liquors, C. A. Crampton, being debarred by the Treasury officials from participating in this work, a report by G. E. Colby on analyses by 8 chemists of a dry red wine by official methods was read by H. W. Wiley. The results were generally satisfactory, and indi-

[1] U. S. Dept. Agr., Div. of Chem. Bul. 38, p. 179.

cated that an accurately graduated spindle can be depended upon for determining the specific gravity if the temperature is carefully controlled. No modifications of present methods were suggested by the reporter or adopted by the convention. On motion of H. A. Huston, the scope of the work was widened to include distilled liquors.

Feeding stuffs.—The report on cattle foods was submitted by H. J. Patterson, and was devoted principally to an account of investigations of methods of determining moisture, drying the ether extract, comparison of the 1.25 and 2.5 solutions for fiber determination, and the separation of the different compounds of the nitrogen-free extract. The following method of determining fiber was also investigated: Two grams of substance was treated with 200 cc. of 1 per cent hydrochloric acid for 2 hours in a tightly corked flask kept in a water bath at a temperature of 95 to 98° C., shaking every 10 minutes. After filtering and washing, the same procedure with 1 per cent alkali was carried out.

The recommendation of the reporter that the use of a 2.5 per cent acid and alkali solution be abandoned was adopted by the Association. It was further recommended that the digestion in closed flasks, as described above, and the direct determination of nitrogen-free extract be made subjects of investigation during the coming year.

In this connection a paper on "A comparison of methods of determining starch in feeding stuffs," by W. E. Stone, was presented. This paper deals with investigations of five methods of starch determination: (1) Sachsse's method—inversion with hydrochloric acid and determination of invert sugar by Fehling's solution; (2) Guichard's method—inversion with nitric acid and polarization; (3) a modification of the latter; (4) Baudry's method—inversion by means of salicylic acid and polarization; and (5) precipitation of starch paste by means of barium hydrate, as proposed by von Asboth. All these methods gave good results with pure starch; in other cases discordant and unexplainable results were obtained, due probably to the presence of pentosans in the materials examined. Xylan was treated by the different methods, and in every case behaved toward the reagents like starch. The use of diastase or malt infusion to separate the starch from the other substances which behave like it toward reagents is recommended.

A brief paper detailing methods of separating the various constituents of nitrogen-free extract was read before the convention by W. H. Krug.

Dairy products.—E. H. Farrington presented a report on this subject, briefly reviewing the past work of the Association and giving an account of the investigations carried out under his direction by a limited number of members of the Association. The work in this line was intended to cover (1) specific gravity by weight and by lactometer, with careful observations of condition, of temperature, etc.; (2) determination of total solids, and (3) determination of fat by extraction of dried solids with ether or other satisfactory solvent.

Observations on the changes in the specific gravity of sweet milk by keeping show that the variations were not uniform nor very great.

A comparison of the calculation of milk solids by Fleischmann's, Babcock's, Hehner and Richmond's, and Richmond's formulas with gravimetric results is reported for 15 samples of milk. The Hehner and Richmond formula gave results most closely agreeing with the gravimetric determinations. The other formulas, especially Babcock's, gave results which were too high.

An account of examinations by C. H. D. Richmond of 75 samples of milk in the lines suggested by the reporter on dairy products is embodied in the report to the Association.

Tests of 2 samples of milk are reported which show no loss of fat on souring. In another case where milk was mixed with sand and allowed to stand, the solids and fat decreased from day to day. This decrease was less when asbestos was substituted for sand.

A paper entitled "Does cream lose fat by keeping for a long time with and without bichromate of potash?" was presented by A. L. Winton. Treated and untreated samples showed practically the same percentage of fat at the end of 3 months as at the beginning of the experiment.

A paper "On the determination of the rise in specific gravity on allowing milk to stand after milking," by C. H. D. Richmond, was presented to the convention. Very slight variations were observed in the specific gravity of 9 samples of milk determined at the end of 1, 6, 18, and 24 hours after milking, although in previous observations by the author in autumn and winter a distinct rise in specific gravity had always been noticed. The results indicate that the slight variation observed could not have been due to change in milk sugar. Salicylic acid appeared to prevent variation.

In a paper "On the determination of albumen in cows' milk," L. L. Van Slyke described the following method: The filtrate from the casein precipitate[1] is heated in a covered beaker in a boiling water bath for 10 to 15 minutes, filtered, the precipitate of albumen washed, removed to the digestion flask, and treated by the Kjeldahl method. In connection with this method, brief directions for determining the total nitrogen compounds in milk, the casein, the albumen, and other nitrogen compounds are given, and attention is called to the crude nomenclature of the nitrogenous constituents of milk now in vogue.

A method of determining the butter fat in milk and cream by difference was described in a paper by S. W. McKeown. The method is as follows: Weigh out 2 gm. of the milk or cream in a crucible lid 1½ to 2 in. in diameter, dry at 212° F., weigh, and immerse in 150 cc. of petroleum naphtha in an upright position for 1 hour or more. Remove from the solution, dry at 212° F. for 30 minutes, and weigh. The results agree closely with those by the Adams method.

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[1] U. S. Dept. Agr., Div. of Chem. Bul. 38, p. 109.

No changes in present methods of analysis of dairy products were recommended.

Report of abstract committee.—A brief verbal report on the subject of abstracting the literature of methods of analysis was submitted by W. Frear. This committee has on hand material which has been accumulated during 2 years past, which it is proposed to publish in the proceedings of this year. The committee was requested by the Association to arrange for the periodical publication of its abstracts in the Experiment Station Record.

The officers of the Association elected for the coming year were as follows: President, H. A. Huston; vice-president, B. B. Ross; secretary, H. W. Wiley; executive committee, F. W. Woll and E. H. Jenkins.

In compliance with the recommendation already mentioned, the reporters for the past year were continued in office another year, and the following associates appointed: Phosphoric acid, H. B. McDonnell; nitrogen, J. P. Street; potash, A. L. Winton; soils and ash, A. Goss; dairy products, L. L. Van Slyke; foods and feeding stuffs, J. B. Lindsey; fermented and distilled liquors, W. P. Bigelow; and sugar, H. H. Nicholson. W. H. Krug was appointed reporter on tanning materials, and G. A. Kerr associate. G. L. Spencer resigned and E. E. Ewell was appointed in his place as reporter on sugar.

The abstract committee remains unchanged.

RECENT WORK IN AGRICULTURAL SCIENCE.

CHEMISTRY.

On the chemical determination of the agricultural value of different natural phosphates, G. PATUREL (*Ann. Agron., 20 (1894), No. 7, pp. 316–348*).—After briefly reviewing the work of other investigators on the assimilability of phosphoric acid in soils and phosphates, the author reports in detail investigations relating to the action of the acids contained in the roots of plants, particularly citric acid, and acids contained in soils, especially acetic acid, on natural phosphates.

These experiments were undertaken principally to determine what basis there is for the preference given in practice to the Boulonnais phosphates as compared with the Somme phosphates.

In preliminary experiments it was found that citrate and oxalate of ammonia did not give reliable indications as to the assimilability of the natural phosphates in the soil. The weak acids (acetic acid proposed by Dehérain and citric acid proposed by B. Dyer) appeared to give results to some extent comparable with those produced by the acids of the soil and of the roots of plants.

The acid reaction is very general in vegetable substances, especially in roots, but the study of these acids is accompanied by the difficulty of securing a sufficient amount of the roots for extraction. By using potato tubers, however, the author obtained an acid extract which was found to contain citric acid. This extract was used for the purpose of testing the extent of the action of the root acids upon various mineral substances, such as marble, apatite, etc., and the results were found to fully confirm those reported by Sachs.

When the Boulonnais and Somme phosphates were treated with citric acid solution the quantity of phosphoric acid dissolved was much higher in the case of the former, a result which conforms to the preference given to this phosphate in practice. However, it appears that the difference in assimilability was not due to the difference in hardness of the two materials, but to a difference in content of carbonate of lime, the Boulonnais phosphate containing 7 per cent of this substance while the Somme phosphate contained 33 per cent.

The difference in assimilability of phosphoric acid can not be explained by simple saturation of the citric acid by the carbonate. The latter appears to present a special obstacle to solution, for a small quantity

of carbonate suffices to destroy the solvent action of a large quantity of acid. This fact was verified in a long series of experiments with phosphates of very different origin and variable content of carbonate of lime.

The author's observations confirm those of Dehérain as regards the presence of free acetic acid in peaty soils. He found an amount of this acid in a soil of this class corresponding to about 7 gm. of acid per kilogram of soil. Comparisons of the solvent action of this acid on the phosphates with that of citric acid showed that acetic acid dissolved the phosphoric acid less readily than the citric acid, but that in this case also the carbonate of lime interfered to a considerable extent with the solution of the phosphates.

The solvent action of carbonic acid on phosphates was also studied, with the result of showing that this acid does not dissolve phosphoric acid to any great extent, but readily dissolves the carbonate of lime, and in this way facilitates the solution of the phosphate of lime by the other acids of the soil.

In conclusion, it is urged that in judging of the quality of a phosphate the assimilability of phosphoric acid in weak acids, as well as the content of carbonate of lime, should be taken into consideration.

A simple method of working up molybdic residues, and some suggestions regarding the determination of phosphoric acid by the molybdic method, H. BORNTRÄGER (*Ztschr. analyt. Chem., 33 (1894), No. 3, pp. 341–343*).—The method proposed for working up the molybdic residues is as follows: Both the acid and ammoniacal filtrates obtained in the determination of phosphoric acid by the molybdic method are poured into a large, wide-necked flask containing 250 cc. of ammonia solution. Immediately, or in a short time, pure molybdic acid separates out in the form of fine needles. When the flask is nearly full the solution is made almost neutral and allowed to stand. It is then filtered, the precipitate washed once, and pressed out. This precipitate is dissolved in the smallest possible quantity of ammonia, the solution filtered quickly to free it from silicic acid, magnesia, etc., and the filtrate diluted with water to a sp. gr. of 1.11 (14° Bé.) at 17° C. Such a solution contains exactly 150 gm. of molybdate of ammonia per liter. To 1 liter of the solution the author adds 1 liter of nitric acid of 1.2 sp. gr., allows the yellow precipitate of traces of phosphoric acid present to subside, and uses the supernatant solution in the determination of phosphoric acid.

In the author's opinion it is not desirable to obtain the ammonium-magnesium phosphate in crystalline form, and to prevent this he adds to the ammonia solution of the yellow precipitate fuming hydrochloric acid until the precipitate formed does not immediately redissolve. The addition of this acid causes the solution to become very hot, which favors precipitation. Magnesia mixture is added to the hot solution and the precipitate filtered off as soon as gas bubbles begin to rise from the precipitate, which is usually in from 1 to 2 hours.

The use of the Barthel spirit lamp instead of the gas burner for igniting precipitates is recommended.

A new method for the quantitative determination of furfurol and pentosans in vegetable materials, C. COUNCLER (*Chem. Ztg., 18 (1894), No. 51, pp. 966–968; and No. 57, p. 1098*).—This method differs from those previously proposed in that the furfurol is precipitated with phloroglucin instead of with phenylhydrazin or pyrogallol. The distillation with HCl is carried on as usual. From 20 to 50 cc. of the distillate is shaken in a bottle with an excess of phloroglucin and then allowed to stand for 12 hours at ordinary temperature. The precipitate is brought upon a weighed filter, dried, and weighed. The furfurol is found by dividing by 2.12 when the weight of the precipitate is 0.2 gm., by 2.05 when 0.05 to 0.1 gm., and by 1.98 when 0.025 gm. From this the pentosans can be calculated as usual.

The determination of specific gravity and fat in curdled milk, M. WEIBULL (*Chem. Ztg., 18 (1894), No. 49, pp. 926–928*).—The author describes his method of determining the specific gravity of sour milk by adding one tenth volume of ammonia (E. S. R., 6, p. 11), and the application of this treatment in determining the fat in sour milk. The fat in the mixture of milk and ammonia is determined by ordinary means, but if the aliquot is to be measured out instead of weighed, a special graduated pipette for this purpose must be used, or a correction made for the difference in adhesion to the pipette.

From a series of determinations the author finds that whole milk loses a slight amount of fat during the first few weeks of souring, amounting in some cases to about 0.05 per cent; but no such loss could be detected in souring skim milk.

Comparison of the common chemical methods for detecting margarin in butter, SEYDA and WOY (*Chem. Ztg., 18 (1894), No. 48, pp. 906, 907*).—From a comparison of the Köttstorfer, Reichert-Meissl, and Hehner methods for fatty acids the authors pronounce the Köttstorfer[1] method the best adapted to detecting margarin in butter, it being rapid and exact.

The oxidation of albuminoids with potassium permanganate, S. BONDZYNSKI and L. ZOJA (*Ztschr. physiol. Chem., 19, No. 3, pp. 225–238*).—Continuing Maly's investigations in this direction, crystallized egg albumen, hæmoglobin, and casein were oxidized with potassium permanganate and the resulting products examined.

On certain methods of determining moisture, S. L. PENFIELD (*Ztschr. anorgan. Chem., 7 (1894), No. 1 and 2, pp. 22–32, figs. 8*).

On the determination of nitrates in potable water by the phenol-sulphonic acid process, A. H. GILL (*Tech. Quart., 1894, Apr., pp. 55–62*).—An account of studies undertaken to determine sources of error in this method and means of avoiding them.

Methods of examining potable water, E. DUCLAUX (*Ann. Inst. Pasteur, 8 (1894), No. 7, pp. 514–527*).—A review.

The analysis of water, W. OHLMÜLLER (*Berlin: J. Springer, 1894, pp. 173, figs. 74, pl. 1*).—A handbook on the chemical, microscopic, and bacteriological examination of water.

[1] Benedikt, Analyse der Fette, second ed., p. 104.

On the judgment of water from a hygienic point of view, W. KRUSE (*Ztschr. Hyg., 17, pp. 1–58; abs. in Chem. Centbl., 1894, II, No. 1, p. 50*).

Determination of starch by alcoholic fermentation, A. MUNSCHE (*Wochenschr. Brauerei, 11, pp. 795–798 and 821–824; abs. in Chem. Centbl., 1894, II, No. 4, p. 220; No. 6, p. 300*).

A hot-chamber refractometer for determining fatty bodies, FÉRY (*Compt. Rend., 119 (1894), No. 5, pp. 332–334, fig. 1*).

Recent work on the sugars, B. B. ROSS (*Amer. Chem. Jour., 16 (1894), No. 8, pp. 549–553*).—A review of recent literature.

Official methods of sugar analysis in the United States (*Sugar Cane, 1894, pp. 411–417*).

Chemical analysis of honey, E. DELTOUR (*Rev. Internat. Falsif., 7 (1894), No. 12, pp. 204–206*).

Clarification of juices containing glucose for analytical purposes, H. C. P. GEERLIGS (*Sugar Cane, 1894, pp. 397–403*).

Recent progress in the examination of wines, honey, flour and bread, water, preserved meat, coffee, spices, etc., E. LIST (*Chem. Ztg., 18 (1894), No. 56, pp. 1069–1072*).

Complete analysis of wine, L. DELAYE (*Rev. Internat. Falsif., 7 (1894), No. 12, pp. 199–204*).

Contribution to the study of certain amid acids obtained by combining vegetable protein substances, E. FLEURENT (*Compt. Rend., 119 (1894), No. 3, pp. 231–233*).—The transformations which aspartic acid derived from legumin and albumin and glutamic acid derived from gluten undergo were studied.

A new alkaloid in coffee, P. PALLADINO (*Atti R. Accad. dei Lincei Roma, 3 (1894), I, pp. 399–403; abs. in Chem. Centbl., 1894, I, No. 26, p. 1155*).—This has the formula $C_{14}H_{16}N_2O_4$, and has been given the name coffearin.

New cellulose derivatives, C. BEADLE (*Jour. Franklin Inst., 138 (1894), No. 2, pp. 100–110*).

On the reaction between molybdic acid and primary and secondary chromate of potassium, R. H. BRADBURY (*Ztschr. anorgan. Chem., 7 (1894), No. 1 and 2, pp. 43–46*).

On the stability of aqueous solutions of bichlorid of mercury, E. BURCKER (*Compt. Rend., 119 (1894), No. 5, pp. 340–342*).

An elementary manual of chemistry, F. H. STORER and W. B. LINDSEY (*New York, Cincinnati, and Chicago: American Book Co., 1894, pp. 453; noticed in Jour. Amer. Chem. Soc., 16 (1894), No. 9, p. 644*).

Report of Oerebro Chemical Station for 1892, J. WIDEN (*Oerebro, Sweden: 1893, pp. 23*).

BOTANY.

Preliminary revision of the North American species of Cactus, Anhalonium, and Lophophora, J. M. COULTER (*U. S. Dept. Agr., Division of Botany, Contributions from the U. S. National Herbarium, vol. 3, No. 2, pp. 91–132*).—The author gives a preliminary revision of the North American species of *Cactus* (formerly *Mamillaria*), *Anhalonium*, and *Lophophora*. The latter is a new genus based on *Anhalonium williamsii*, to which are ascribed 1 species and a variety. Of the other genera, 64 species and varieties of *Cactus* and 4 of *Anhalonium* are described, many of which are reported as new. Brief notes are given on the geographical distribution of the genera included in the revision.

Plants grown under different colored glass (*Gard. Chron., 16 (1894), ser. 3, p. 130*).—M. Villon is reported as having just concluded a series of experiments on the cultivation of plants under colored glass. Plants were potted in cases in which the panes of glass could be easily replaced by others of different shades. The following kinds of colored glass were used: (1) Glass made orange color by a coating of bichromate of potash, allowing only the yellow and red rays to pass through; (2) violet glass colored with manganese, which absorbs the yellow and blue rays of the spectrum; (3) blue glass colored with cobalt, allowing only the red and ultra-violet rays to pass; (4) blue glass colored with copper, allowing only the ultra-violet rays to pass and absorbing the extreme red rays; (5) glass covered with a thin layer of silver, allowing only the blue rays to pass; (6) uranium glass, absorbing the light to a great extent; (7) gilded glass; (8) glass colored red with protoxid of copper, absorbing all the colors of the spectrum between red and blue; and (9) glass colored green with protoxid of iron, absorbing the red rays.

Taking the growth of the plants under white glass as 100, the following results were obtained:

Comparative growth of plants under glass.

Under orange glass	150	Under silvered glass	60
violet glass	150	uranium glass	40
cobalt blue glass	140	gilded glass	40
copper blue glass	120	red glass	15
white glass	100	green glass	10

These experiments show that the light that favors vegetation most is the orange light of the chromic glass and the violet of the manganese glass, and as the radiations that these glasses allow to pass are the red and violet, these rays are the ones that seem to be most favorable to the development of plants. However, the growth under no glass at all, wherever possible, is decidedly the best of all.

The formation and decomposition of organic acids by the higher plants, K. PURJEWICZ (*Kiew: 1893, p. 90, table 1; abs. in Bot. Centbl., 58 (1894), No. 11, pp. 368–374*).—The author gives in an introductory chapter a review of the extensive bibliography of this subject. The paper itself is divided into three parts, as follows: (1) Decomposition of the acids, (2) their formation, and (3) the gas exchange brought about by both processes.

The author found that decomposition of the organic acids in plants takes place (1) under the influence of light, (2) a higher temperature, and (3) by constantly keeping in the dark at the ordinary temperature. He investigated 24 species of phanerogams and found the decomposition in light was constant. Also in etiolated plants and chlorophyll-free parts the same process takes place. He found the roots of *Phaseolus* in 5 hours had their acidity decrease from 67 to 60 per cent, and in etiolated germinating wheat plants there was a decrease of 8 points

in 3 hours. The claim that the decomposition in the light is the result of partial oxidation the author found to be correct, the acidity of *Oxalis* plants kept for 4 hours in air, in hydrogen, and in darkness, being respectively 813, 882, and 903.

The decomposition of organic acids at high temperatures, 35 to 40° C., is common. This is shown by subjecting parts of plants that have already lost part of their acidity to higher temperatures, when the decomposition continues.

When plants are taken from the sunlight into darkness and kept at the room temperature for a considerable time, an increased activity of acid formation takes place, followed later by decomposition. This period varies for different plants, being 8 hours for *Crassulaceæ* and 24 hours for *Robinia*, with *Oxalis* and *Pelargonium* intermediate. This difference the author thinks may be due to the different kinds of acids contained in the plants.

In common with others the author thinks the decomposition of organic acids is a process which all plants have in common. It is promoted by sunlight and high temperature, and may be temporarily checked by the opposing process of acid formation by changing plants from sunlight to darkness.

The production of organic acids takes place when a plant is kept in the dark at ordinary temperature, but after several hours in darkness decomposition will take the place of construction. The influence of temperature on acid production was investigated, and a temperature of 12 to 15° C. found to be best.

The influence of oxygen was tested in an atmosphere of hydrogen. It was shown that oxygen is more important to acid formation than to its decomposition.

The author thinks there is a close relation between the production and decomposition of the organic acids and the character of the gas exchange taking place in the dark. A similar relationship is shown in the case of a high temperature as well as in darkness. With the increase of the acid decomposition the ratio between the oxygen and carbon dioxid of respiration, or the respiration quotient, as the author calls it, begins to increase and continues to do so for several days. An experiment with *Sedum hybridum* showed, at the time of placing the plant in the dark, for its respiration quotient 0.44, 2 days later 0.7, and after 3 days more 1.05, while the acidity of the plant had fallen from 360 to 300. With germinating seeds the respiration quotient first falls and then rises, while the degree of acidity reaches its maximum at the minimum period of respiration.

The author thinks that all things tend to prove that organic acids in plants are the result of imperfect oxidation of the carbohydrates and not by-products of albuminoid synthesis. The decomposition of the acids often depends on their change by oxidation to carbon dioxid. This may not take place all at once, but gradually by progressive steps

it becomes a simpler acid. It is not improbable that the entire respiration process is not simply a complete oxidation of the carbonic acid but that it is accomplished by a train of successive oxidations, which at first build up the higher, then simpler organic acids, finally ending with carbon dioxid.

On the respiration of leaves, L. MAQUENNE (*Compt. Rend., 119 (1894), No. 1, pp. 100–102*).—The author claims that weighing and analyzing the gas given off by a plant during respiration is not a proper means for determining the amount of oxygen taken in and carbon dioxid given off, as under certain conditions ordinary oxidation plays a very important part.

He affirms that there are two kinds of respiration (1) normal, when the oxygen taken in and the carbon dioxid eliminated are equal, and (2) respiration augmented by the oxidation of previously elaborated material in the leaves resulting in a much greater evolution of carbon dioxid than in the normal process. In the second place, if the leaf be protected from the air and no oxidation permitted, the reserve material will go on accumulating, and when finally placed in the air the amount of carbon dioxid liberated should be correspondingly augmented. The ordinary experiments with intercellular respiration will demonstrate the first hypothesis. The other was shown by placing detached leaves from several plants in the receiver of a mercury air pump and keeping them there for a considerable time, after which air was admitted and the increased liberation of carbon dioxid noted. In order to eliminate errors arising from individuality, the leaves were taken in pairs from the same plant, choosing those as nearly as possible of the same weight and age. The gas was drawn off by a method devised by Dehérain and the author, and was measured and analyzed in a Schlösing eudiometer used as a volumenometer. The results of his experiments are given in the following table:

Carbon dioxid liberated by detached leaves.

	Weight.	Temperature.	4 hours in a vacuum.	1 hour in air.	
				Normal conditions.	After being in a vacuum.
	Gm.	*Deg. C.*	*Cc.*	*Cc.*	*Cc.*
Euonymus japonica	3.05	16	1.4	0.66	1.06
Do	3.25	14	1.2	0.61	0.89
Do	3.50	14	1.1	0.73	1.01
Do	4.30	20	1.7	1.48	1.90
Do	4.65	14	1.2	0.66	1.07
Syringa sp	4.55	18	2.5	1.39	2.02
Do	2.95	21	2.0	0.80	1.51
Do	3.80	21	2.5	1.07	1.96
Chieranthus sp	3.70	18	1.9	1.22	2.43
Do	3.75	20	2.0	1.87	2.76
Aster sp	3.20	20	1.9	1.52	2.47
Buxus sp	4.00	20	2.0	1.34	1.54

These experiments could not be conducted with more delicate leaves, such as wheat, lucern, or potato, as they will not live when subjected

to a vacuum for a considerable time, but wilt, turn yellow, and take on a peculiar odor indicative of a changed condition of their tissues.

The absorption of oxygen is influenced in the same way as has been shown for the liberation of carbon dioxid.

The respiration of green and etiolated leaves, W. PALLADIN (*Mitt. Univ. Charkow, pp. 24; abs. in Bot. Centbl., 58 (1894), No. 11, pp. 375–377*).—Numerous experiments were made with leaves of *Vicia faba* by the Pettenkofer method for estimation of the CO_2 in the respiration of green and etiolated leaves.

Freshly cut leaves showed a very low respiration, which the author thinks is due to the low carbohydrate content of the leaves. If both green and etiolated leaves be placed for some time in a cane-sugar solution they will take up a considerable amount of the carbohydrates, which will be shown almost immediately by the increased respiration of the leaves. However, if they are placed in distilled water a corresponding loss will be noticed. This seems to be a demonstration of the effect of the carbohydrate content of leaves on their respiration.

The author established as the unit of respiration intensity the amount of carbon dioxid given off in 1 hour for each 10 gm. of albuminoid substance in the leaf. The amount of albuminoids was estimated from the dry substance, and the freshly cut leaves were found to have a constant percentage of albuminoids in their dry substance, it being 44.6 per cent for etiolated and 38.7 for green leaves of *Vicia faba*. Based on this proportion, the average of 4 experiments gave as the respiration intensity of etiolated leaves 169.3 mg., and of 2 experiments for the green ones 163.3 mg., showing that the respiration intensity is proportionate to the carbohydrate content of each.

The increased respiration of leaves as a consequence of their having been placed for some time in a sugar solution might be attributed to the action of some fungi or bacteria, but this the author showed could not be the case by keeping leaves for a long time in the solution and estimating their respiration from time to time. The amount was found to be nearly constant instead of increasing, as would be the case if due to bacteria or fungi.

With lupines and wheat the relation between the CO_2 given off and the albuminoid content of leaves was not determined. The relation as shown by the intensity of the respiration of green and etiolated leaves of wheat is not always constant. The author considers, as shown by his experiments with wheat, that etiolated leaves of stemless plants, as a result of their being richer in glucose, have a greater respiration than stalked plants.

The respiration coefficient (CO_2: O_2) in the etiolated leaves of *Vicia faba* is between 0.72 and 0.76 when kept in the sugar solution. If kept in distilled water it falls to 0.63 to 0.65. The corresponding figures for green leaves are not given.

Crystals of ice on plants, J. C. Bay (*Bot. Gaz., 19 (1894), No. 8, pp. 321–326*).—The author gives a bibliography of literature, a list of plants on which crystals have been observed, forms of crystals, formation of crystals, and conditions for the formation of crystals. The cold causes a contraction of the tissues all over the plant, and consequently the turgescence, as well as the permeability of the cell walls to water, is greatly diminished. As the contents of the peripheral ends of the medullary rays freeze, expand, and are pressed forward the stem splits in the place of least resistance, and the ice forms a layer covering the whole surface of the wound. The pressure from inside furnishes water, the latter being drawn up by capillary force. Where no splitting results, the difference in the coefficient of contraction, being different for the different tissues, will explain the formation of the crystals.

Concerning generic descriptions, D. Clos (*Bul. Soc. Bot. France, 41 (1894), No. 5, pp. 390–400*).—A criticism on the insufficiency of generic descriptions in defining and limiting genera.

Monograph of Oscillatoriæ, M. Gomont (*Paris: G. Masson, 1893, 8vo., pp. 310, pls. 16; abs. in Bul. Soc. Bot. France, 41 (1894), No. 5, pp. 408–411*).

Concerning the structure and systematic relationship of Ditiola radicata, G. Lindau (*Hedwigia, 33 (1894), No. 4, pp. 234–240, pl. 1*).—Description, life history, and botanical position of *Ditiola radicata*.

Contributions to the embryology of the Amentiferæ, I, M. Benson (*Trans. Linn. Soc., 2d ser., Bot., vol. 3, pt. 10, pp. 409–429, pls. 6*).—Studies in the embryology of the *Cupuliferæ, Coryleæ, Betulineæ, Salicineæ*, and *Juglandaceæ*.

Hermaphroditism in the plant world, A. Chatin (*Bul. Soc. Bot. France, 41 (1894), No. 5, pp. 386–390*).

Observations on the presence of tendrils or tendril-like organs in certain fungi, E. Boudier (*Bul. Soc. Bot. France, 41 (1894), No. 5, pp. 371–375, fig. 1*).—The occurrence of simple tendril-like organs, probably trichomes, in several species of fungi is mentioned, figured, and described.

On the activity of assimilation by leaves, R. Meissner (*Inaug. Dissertation, Bonn; abs. in Bot. Ztg., 52 (1894), No. 16, pt. 2, pp. 250, 251*).

The measure of water absorption by roots, H. Lecomte (*Compt. Rend., 119 (1894), No. 2, pp. 181, 182*).—A tree trunk (*Musanga smithii*) of about 40 mm. in diameter absorbed water through its roots at the rate of 0.360 to 0.711 liters per hour.

Concerning the disposition of tannic acid in plant metabolism (*Program Realschule, Holstenthore, Hamburg, 1893, pp. 38; abs. in Bot. Centbl., 59 (1894), No. 9 and 10, pp. 280, 281*).

Concerning the fate of chlorophyll grains in seeds and sprouts, A. Famitzin (*Arbeit. bot. Lab. Akad. St. Petersburg, 1893, No. 5, pp. 16; abs. in Bot. Centbl., 58 (1894), No. 11, pp. 378, 379*).

The carbohydrates of mushrooms, E. Bourquelot (*Bul. Soc. Mycol. France, 10 (1894), No. 3, pp. 133–140*).

The composition of cell membranes of certain fungi, especially Polyporus, L. Mangin (*Bul. Soc. Bot. France, 41 (1894), No. 5, pp. 375–384*).—The author objects to the use of fungus cellulose as a term describing the constitution of the cell walls of fungi, as it is not sufficiently comprehensive in many cases.

The nitrogen in poppy capsules, G. Clautriau (*Bul. Soc. Micr. Belge, 18 (1894); abs. in Bot. Ztg., 52 (1894), No. 16, pt. 2, pp. 249, 250*).

Localization and signification of the alkaloids of certain seeds, G. Clautriau (*Bul. Soc. Micr. Belge, 18 (1894); abs. in Bot. Ztg., 52 (1894), No. 16, pt. 2, pp. 252, 253*).

Concerning the seed coats of Brassica and Sinapis species, O. BURCHARD (*Jour. Landw., 42 (1894), pp. 125-136, pls. 4*).

Abnormal bark formation in Picea excelsa and Abies pectinata, G. HENSCHEL (*Forstl. naturw. Ztschr., 3 (1894), No. 8, pp. 335, 336, fig. 1*).

Fertilization of the vanilla flowers by bees, C. DE VARIGNY (*Jour. Bombay Nat. Hist. Soc., 8 (1894), No. 4, pp. 555, 556*).—A brief note on fertilization by bees instead of hand pollination.

Popular American plant names, F. D. BERGEN (*Jour. Amer. Folk Lore, 7 (1894), No. 25, pp. 89-104*).—An extensive list of popular names with scientific equivalents.

Flora of the eastern coast of the Malay peninsula, H. N. RIDLEY (*Trans. Linn. Soc., 2d ser., Bot., vol. 3, pt. 9, pp. 267-408, pls. 6*).

BACTERIOLOGY.

On a coprolite bacterium of the permian periods, B. RENAULT and C. E. BERTRAND (*Compt. Rend., 119 (1894), No. 6, pp. 377-379*).—The organism which is named *Bacillus permiensis* was observed in coprolites of ichthyophagous vertebrates in bituminous schists of Cordene and in schists from Igomay.

Bacteria feeding on saltpeter, A. STUTZER and R. BURRI (*Deut. landw. Presse, 21 (1894), No. 63, p. 610*).—A brief note on an unnamed species.

METEOROLOGY.

Meteorological summary (*Arkansas Sta. Bul. 27, p. 86*).—A summary of observations at the substation at Newport from April to October, 1893.

Meteorological summary for June, 1894 (*Massachusetts State Sta. Bul. 53, p. 1*).—A summary of observations on temperature, rainfall, and movement of wind.

Rain-making, F. SANFORD (*Pop. Sci. Monthly, 1894, Aug., pp. 478-491*).

Frequency of amounts of precipitation, M. W. HARRINGTON (*Amer. Met. Jour., 11 (1894), No. 4, pp. 123-134*).

Precipitation and temperature and their effects on crop production in Texas for the year 1893, I. M. CLINE (*Amer. Met. Jour., 11 (1894), No. 4, pp. 134-142*).—The results of observations are summed up and the relations of these meteorological conditions to the growth of cotton, corn, wheat, oats, truck, fruits, and forage crops are discussed.

Protection of farm buildings against lightning, J APPEL (*Tidskr. Landökon., 13 (1894), pp. 337-348*).

Elementary meteorology, W. M. DAVIS (*Boston, New York, and Chicago: Ginn & Co., 8vo., cloth, XII + 355 pp.*).

AIR AND WATER.

The variation in the carbonic acid content of atmospheric air, H. PUCHNER (*Forsch. Geb. agr. Phys., 27 (1894), No. 1 and 2, pp. 203-208*).

The composition of rainwater, A. LÉVY (*Ann. l'Observ. Munic. Montsouris, 1892 and 1893. Paris: pp. 311; abs. in Forsch. Geb. agr. Phys., 27 (1894), No. 1 and 2, pp. 217, 218*).

On the sterilization of water, L. GRIMBERT (*Jour. Pharm. et Chim., 30 (1894), No. 2, pp. 60, 61*).—Heat in closed beer bottles at boiling temperature for half an hour.

The electrical purification of water, T. M. DROWN (*Tech. Quart., 1894, Apr., pp. 51-54*).—Purification by setting free oxygen by means of electricity is deemed impracticable. Purification by means of electrolysis of salt solution resulting in formation principally of hypochlorite of soda is more effective, but of doubtful economy.

Report of the examination of the Berlin city water from November, 1891, to March, 1894, C. GUNTHER and F. NIEHMANN (*Arch. Hyg., 21, No. 1, pp. 63–96*).

Bacteriological examination of well and service water of Basel, K. VON CHOMSKI (*Ztschr. Hyg., 17, pp. 130–163; abs. in Chem. Centbl., 1894, II, No. 1, p. 52*).

SOILS.

On the nitrogen contents of soil humus in the arid and humid regions, E. W. HILGARD and M. E. JAFFA (*Agl. Sci., 8 (1894), No. 4, pp. 165–171*).—It had been observed that although analysis showed soils of arid regions as a rule to contain a much lower per cent of humus than those of humid regions, applications of nitrogenous fertilizers frequently "proved ineffectual and even injurious, proving plainly that the soil was not nitrogen-hungry." It was therefore concluded "that if the small amount of humus suffices in the case of arid soils to satisfy the demands for nitrogen, the humus must be richer in nitrogen than usual." The results of examinations of humus in 26 carefully selected samples of soils from arid and semiarid regions and of 8 from humid regions fully confirm this view. The average results are as follows:

Humus and nitrogen in soils of arid and humid regions.

	No. of samples.	Humus in soil.	Nitrogen in humus.	Nitrogen in soil.
		Per cent.	*Per cent.*	*Per cent.*
Arid soils	18	0.75	15.87	0.101
Semiarid soils	8	0.99	10.03	0.102
Humid soils	8	3.04	5.24	0.132

"It thus appears that on the average the humus of the arid soils contains three times as much nitrogen as that of the humid." In some cases it was observed that the difference went as high as over 6 to 1, the per cent of nitrogen in the humus exceeding that of the albuminoid group.

"It thus becomes intelligible that in the arid region a humus percentage which under humid conditions would justly be considered entirely inadequate for the success of normal crops may nevertheless suffice even for the more exacting crops."

The influence of plant cover on soil temperature, moisture, drainage, and evaporation, E. WOLLNY (*Forsch. Geb. agr. Phys., 17 (1894), No. 1 and 2, pp. 153–202, fig. 1*).—This is a third contribution by the author to forestry meteorological observations, and reports the results of a continuation of the experiments described in the former papers.[1] The principal conclusions of the author may be briefly summarized as follows:

[1]For previous papers see Forsch. Geb. agr. Phys., 10 (1887), pp. 415–446; 13 (1890), pp. 134–184.

(1) A soil covered with living trees or leafy plants is generally cooler in summer and warmer in winter than one not so covered. The greatest difference in temperature occurs in summer, is less in spring and autumn, and may entirely disappear in winter; *i. e.*, with rising temperature the difference is considerable, while with falling temperature it is less marked. The differences are also greater with forest plants than with agricultural plants. In case of both forest and field plants the soil temperature is influenced by the stand, the rate of development of the above-ground organs, and the habits of growth of different species. The thicker the stand and the more vigorous the above-ground growth the greater the effect on the temperature. The heavier the covering of litter the greater the influence on the temperature. The variations of temperature are decidedly lessened by a plant cover, and this influence is increased by the presence of a covering of litter. The difference in temperature between covered and bare land is most marked at the periods of maximum and minimum daily temperature. The difference between morning and evening temperature is greater on bare soil than on covered soil.

(2) A soil covered with growing plants contains less moisture than a bare soil. Cultivation is generally of the highest value in summer, but is of less value in spring and fall. As in the case of temperature, the soil moisture is dependent upon the stand and rate of growth of the plants with which it is covered. A soil having a covering of litter in addition to that of trees generally contains more moisture than that bearing trees only, but it was observed that the influence of the cover of litter might be lessened by the increased growth of trees in this case drawing a larger amount of water from the soil. In fact in the later stages of growth the decomposition of the litter furnishes material for such a vigorous growth that the influence of the cover of litter on the moisture content of the soil is entirely overcome.

(3) Drainage is less from covered than from bare soils. The difference is greatest in summer, and decreases steadily until the following spring. Drainage is greater with evergreens (pines) than with foliaceous trees (birches) and grasses. A covering of litter retards the sinking of the water into the lower layers of the soil. In bare soils the drainage generally increases and decreases with the rainfall, and therefore in regions of summer rain the most abundant drainage would be observed in summer. Under such conditions, however, relatively the smallest amount of water would be carried down in the drainage in summer, the greatest in the cold season. On covered soil as compared with fallow soil the minimum amount of drainage is in summer and increases until the following spring.

In soils covered with plants the relation between drainage and rainfall is qualitatively the same at different seasons of the year as in bare soils.

In the mild winters of 1889–'90, 1891–'92, and 1892–'93 the greatest amount of drainage occurred at this season, while in all cases where

during the winter the soil was wholly or in part frozen, as in 1887–'88, 1888–'89, and 1890–'91, the greatest drainage was observed after the soil thawed in the spring.

(4) Soils covered with growing plants evaporate considerably more water than bare soils. Evergreen trees (pines) transpire more water than leafy trees (birches), and the latter more than grass. Trees growing on a soil covered with litter under otherwise corresponding circumstances, give off more water than those growing on uncovered soil.

Investigations of soil temperatures, 1892–'93, J. SEBELIEN (*Norsk Landmandsblad, 13 (1894), pp. 249–253*).—The temperature of the soil at depths of $\frac{1}{4}$, $\frac{1}{2}$, and 1 meter was ascertained by tridaily observations for the year November 1, 1892, to October 31, 1893. Two sets of readings were obtained, at Aas Agricultural College and at Jönsberg Agricultural School, both in Norway. The observations are summarized in the paper by groups of 5 days and the results discussed. To allow of more ready comparison of the changes occurring during the year the monthly averages have been calculated in the following table, both for the temperature of the soil at the depths given and for the air temperature during the same time.

Soil temperatures at different depths by months.

Month.	Aas Agricultural College.				Jönsberg Agricultural School.			
	Air temperature.	Soil temperature at depths of—			Air temperature.	Soil temperature at depths of—		
		$\frac{1}{4}$ meter.	$\frac{1}{2}$ meter.	1 meter.		$\frac{1}{4}$ meter.	$\frac{1}{2}$ meter.	1 meter.
1892.	*Deg. C.*	*Deg. C.*	*Deg. C.*	*Deg. C.*	*Deg. C.*	*Deg. C.*	*Deg. C.*	*Deg. C.*
November	3.6	3.3	4.2	6.0	2.8	1.3	2.8	4.5
December	6.3	0.9	0.8	3.1	7.9	1.5	0.7	2.8
1893.								
January	9.1	2.4	0.6	1.8	11.7	3.5	1.2	1.4
February	10.3	2.1	0.7	1.4	15.4	5.0	2.7	0.4
March	1.5	0.4	0.2	1.3	2.4	1.9	1.2	0.1
April	4.1	2.1	1.3	2.1	3.8	1.4	0.1	....
May	9.8	9.6	8.2	7.0	7.9	7.2	2.7	....
June	10.3	13.7	12.6	11.0	14.2	16.0	12.5	9.3
July	17.1	17.0	15.6	13.6	15.9	17.7	15.9	11.5
August	14.8	16.1	15.6	14.0	12.9	13.6	13.2	11.4
September	8.9	11.4	11.6	12.3	7.4	9.0	9.5	9.9
October	4.9	7.2	7.7	9.2	....	5.0	6.0	7.5

NOTE.—Ground covered with snow January 4 to beginning of April at Aas; from November 17 to 28 and January 2 to beginning of April at Jönsberg; 1-meter thermometer at Jönsberg out of order March 21 to June 6.

The soil at Aas was heavy clay, while that at Jönsberg was black pulverized alum slate. The results show that the deeper we go into the soil the more evenly the temperature changes and the more slowly the variations are influenced by the great and sudden changes in the temperature of the air.—F. W. WOLL.

On the soils of São Paulo, Brazil, F. W. DAFERT and A. B. U. CAVALCANTI (*Relat. Inst. Agron. São Paulo, Brazil, 1893, pp. 69–72*).—Mechanical and chemical analyses of 33 samples of soil from different

parts of the province, made during the year, are reported, and the results are discussed in connection with those of analyses in previous years (67 in all). The percentages of nitrogen found are of special interest. These vary from 0.009 to 0.457, the average for the 67 analyses being 0.13. These results prove the error of the statements as to the great richness of tropical soil in nitrogen. The amounts of humus present were not large, and it was found by direct experiment that the soils of São Paulo are generally benefited by nitrogenous manuring.

Chemical examination of samples of soil from Norrbotten marshes, Sweden, M. RUBIN (*Kgl. Landt. Akad. Handl. Tidskr., 33 (1894), pp. 3–13*).—Complete analyses are given of 9 samples of soil from marsh lands in northern Sweden, with the specific weight of the samples and the weight of organic matter, water, ash constituents, and nitrogen per hectare 20 cm. deep. The main results of the analyses are condensed in the following table:

Analyses of soil from Swedish marsh lands.

Sample number.	Weight per liter.	In dry substance.				
		Organic matter.	Nitrogen.	Phosphoric acid.	Calcium oxid.	Potassium oxid.
	Grams.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
1	316.6	92.3	3.21	0.04	0.28	0.06
2	269.3	97.1	2.89	0.02	0.51	0.04
3	315.6	87.8	3.00	0.02	0.27	0.06
4	340.0	88.5	3.21	0.14	0.29	0.05
5	301.0	92.6	3.08	0.05	0.20	0.07
6	389.0	93.9	3.00	0.03	0.29	0.04
7	434.0	61.5	1.63	0.05	0.89	0.09
8	389.0	93.4	2.53	0.16	0.97	0.03
9	532.2	41.5	1.54	0.06	0.24	0.02

The author is of opinion that the soils examined would be improved in most cases by applications of quicklime at the rate of 1 to 2 tons per acre, or of carbonate of lime, and of about 90 lbs. of potash in the form of high-grade muriate.—F. W. WOLL.

On certain final geological and climatic phases of Barbary soils, A. POMEL (*Compt. Rend., 119 (1894), No. 5, pp. 314–318*).

Investigations concerning the heat capacity of soil constituents, R. ULRICH (*Forsch. Geb. agr. Phys., 27 (1894), No. 1 and 2, pp. 1–31*).

On the organic compounds of humus soil, G. ANDRÉ (*Bul. Soc. Chim. Paris, 11–12 (1894), No. 15, pp. 771–781*).—See E. S. R., 4, p. 859.

Recent researches on the microörganisms of the soil which fix nitrogen, BERTHELOT (*Bul. Soc. Chim. Paris, 11–12 (1894), No. 15, pp. 784–793*).—See E. S. R., 4, p. 854.

Soil inoculation for leguminous plants, F. NOBBE and L. HILTNER (*Fühling's landw. Ztg., 43 (1894), No. 12, pp. 371–376*).—A general discussion with brief references to experiments made by the authors in 1890, 1891, and 1893.

FERTILIZERS.

The relative value of phosphoric acid from different sources, C. E. THORNE and J. F. HICKMAN (*Ohio Sta. Bul. 53, pp. 31, 32*).—The following table gives the average increased yield per acre on plats devoted to the continuous culture of corn, wheat, and oats, and fertilized with different forms of phosphoric acid, the tests extending over 6 seasons in the case of corn, 5 for wheat, and 4 for oats:

Increased yield per acre with different forms of phosphoric acid.

Fertilizer per acre.	Increase of grain.			Increase of straw.		
	Corn.	Wheat.	Oats.	Corn.	Wheat.	Oats.
	Bushels.	*Bushels.*	*Bushels.*	*Pounds.*	*Pounds.*	*Pounds.*
320 lbs. dissolved boneblack	4.3	4.0	5.6	383	1,509	253
320 lbs. acid phosphate	7.3	4.2	5.5	867	945	507
300 lbs. basic slag	7.2	4.6	7.0	686	1,017	444

"The plat receiving basic slag has had a somewhat larger total quantity of phosphoric acid per acre and that receiving acid phosphate a somewhat smaller quantity than that applied in the boneblack, but apparently the phosphoric acid found in . . . the Carolina rock is equally efficacious, pound for pound, with that found in bones . . . when both have been converted into superphosphate, and the mineral phosphoric acid of the basic slag is not inferior to the most active forms of the same substance as derived from bones.

"Should some way be discovered by which the greater growth of [wheat] straw produced by the boneblack superphosphate may be made to bear a proportionate quantity of grain, a greater value would have to be assigned to that form of phosphoric acid than the results thus far attained will justify; but at present this excessive production of straw must be looked upon as a disadvantage, in the light of the results in 1891, when every plat dressed with boneblack superphosphate gave a smaller yield of grain than the unfertilized plats adjoining, although the straw was enormously increased, while the rock and slag phosphates gave a more moderate increase of straw with a small increase of grain."

On the conservation of animal manure in the climate of São Paulo, Brazil, F. W. DAFERT (*Relat. Inst. Agron. São Paulo, Brazil, 1893, pp. 73–75*).—The losses during 2 months under different ways of keeping manure were briefly as follows:

Loss of dry matter and nitrogen in manure.

	Loss of dry matter.		Loss of nitrogen.	
	Without plaster.	With plaster.	Without plaster.	With plaster.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Stored under cover and kept dry	30.3	50.8	44.3	12.4
Stored under cover and kept moist	22.6	35.7	13.9	30.9
Exposed to the sun and kept dry	19.5	31.7	33.8	10.2
Exposed to the sun and kept moist	29.0	53.1	21.0	37.0

The cost of manuring in systems of farming with and without stock, K. MÜLLER (*Landw. Jahrb., 23 (1894), No. 2 and 3, pp. 167–332*).—This is an elaborate report, presenting detailed statistics of the comparative cost, under European conditions, of manuring in systems of farming in which (1) a large amount of stock, (2) a small amount of stock, and (3) no stock is kept, the comparative merits of commercial fertilizers, green manuring, night soil, sewage, etc., being discussed.

The author concludes that green manuring, supplemented by commercial fertilizers, is suited to almost all conditions. Under favorable soil conditions manuring with artificial fertilizers may be exclusively practiced. The economy of the use of night soil, sewage, sweepings, factory waste, composts, etc., and bought stable manure depends upon local conditions, and these materials should be used only when they are cheaper than the more generally applicable system of green manuring supplemented by commercial fertilizers.

Although it is believed that in some cases the circumstances may warrant the reduction or total abandonment of stock-raising, and the substitution of some of the above systems of manuring, it is not safe to conclude that such is generally advisable. In deciding this question there are other important factors besides cost of manure to be taken into consideration.

Analyses of commercial fertilizers, M. A. SCOVELL (*Kentucky Sta. Rpt. 1890, pp. 122–134*).—A reprint of Bulletin 29 of the station (E. S. R., 2, p. 227).

Analyses of fertilizers at Massachusetts State Station (*Massachusetts State Sta. Bul. 53, pp. 2–8*).—A schedule of trade values and tabulated analyses of 91 samples of fertilizing materials, including factory-mixed goods, dissolved boneblack, nitrate of soda, tankage, ground bone, wood ashes, cotton-hull ashes, lime-kiln ashes, slaked lime, wool waste, muck, goose manure, hen-house refuse, and soot.

Coöperative experiments with fertilizers on corn, M. A. SCOVELL (*Kentucky Sta. Rpt. 1890, pp. 79–100*).—Reprinted from Bulletin 26 of the station (E. S. R., 2, p. 143).

The permanency of effect of potash fertilizers, M. A. SCOVELL (*Kentucky Sta. Rpt. 1890, pp. 101–104*).—Reprinted from Bulletin 26 of the station (E. S. R., 2, p. 143).

Practical guide for manuring, H. FAYET (*Paris: Larousse, 1894, 2d ed., pp. 200*).

Artificial fertilizers in the Puisaye, POTIER (*Ann. Agron., 20 (1894), No. 6, pp. 263–291*).—Comparisons of different artificial fertilizers on wheat, forage plants, sugar beets, and potatoes.

The fertilizer industry of the United States (*L'Engrais, 9 (1894), No. 33, p. 783*).—Statistics showing number of fertilizer establishments in the different States and Territories of this country, capital invested, amount and wages of labor employed, amount and value of fertilizers produced, etc., taken from *American Fertilizer*.

The nitrogen question, H. EDSON (*Sugar, 6 (1894), p. 128*).—The author reports finding 17.3 lbs. of nitrogen per acre in *Stellaria media* which had grown during the winter in cane fields. This is about one half the amount of nitrogen in the fertilizers employed each year, and was saved from being washed away by permitting the ground to be covered with the weed. He advises the growth of such weeds and turning them under in the spring to prevent loss of nitrogen by washing from the soil during the winter.

Recent researches on the fixation of atmospheric nitrogen by microörganisms, BERTHELOT (*Bul. Soc. Chim. Paris, 11–12 (1894), No. 15, pp. 781–784*).—See E. S. R., 4, p. 502.

The action of red clover as a preliminary crop, H. CLAUSEN-HEIDE (*Deut. landw. Presse, 21 (1894), No. 66, p. 633*).—Clover seeded in rye and turned under for the succeeding crop of potatoes improved both the yield and the quality of tubers.

Manuring with ground bone, M. ULLMANN (*Hamburg: L. Gräfe & Sillem, pp. 128*).

The value of Gellivara apatite and some other phosphates for Swedish agriculture, L. F. NILSON (*Tidskr. Landtmän, 15 (1894), pp. 514–519*).

Lime and fertilizers, W. F. MASSEY (*Cult. and Country Gent., 1894, July 26, p. 548*).—A popular article explaining the relation of lime and other fertilizers to nitrification and to the growth of leguminous plants.

On the choice and use of artificial manures, F. B. GUTHRIE (*Agl. Gaz. N. S. W., 1894, May, pp. 328–330*).—Precautions to be observed in the purchase of manures and popular directions as to the use of different kinds of fertilizers.

On the choice and use of artificial manures, F. B. GUTHRIE (*Agl. Gaz. N. S. W., 1894, June, pp. 419–423*).—General notes on the use of burnt lime, carbonate of lime, gypsum, and phosphatic manures, including steamed bone, bone meal, fermented bones, and boneblack.

The using of artificial manures in market gardening, M. ULLMANN (*Hamburg: L. Gräfe & Sillem, pp. 128*).

On the use of mineral manures (*Gard. Chron., 16 (1894), ser. 3, pp. 154, 155*).—A report on the use in the garden of (1) nitrate of potash; (2) phosphate of potash; (3) nitrate and phosphate of potash; (4) Wagner's flower and garden manure (phosphoric acid 13 per cent, potash 11, nitrogen 13); Albert's garden manure (phosphoric acid 16 per cent, potash 20, and nitrogen 13), and Albert's hop manure (phosphoric acid 13 per cent, potash 25, and nitrogen 13).

Influence of the method of application of fertilizers on their utilization by plants, A. PRUNET (*Rev. gén. Bot., 16 (1894), No. 66, pp. 260–269*).—See abstract E. S. R., 5, p. 1091.

The preservation of manure, SCHMIDT and GERLACH (*Deut. landw. Presse, 21 (1894), No. 62, pp. 597, 598*).—The results of experiments conducted in 1893–'94.

FIELD CROPS.

Alfalfa, C. L. INGERSOLL (*Nebraska Sta. Bul. 35, pp. 163–177, pl. 1*).—Relative yield of alfalfa and other forage plants, notes on the history of alfalfa, description of the plant, direction for cultivation, composition of alfalfa, and letters from growers of alfalfa in Nebraska. The yield of alfalfa on the station farm was at the rate of 12,720 lbs. of hay per acre secured in 3 cuttings.

The following table gives the yield in 1893 of hay from alfalfa at the first cutting, and from other plants grown in comparison with it:

Yield of hay per acre.

	Pounds.		Pounds.
June clover	2,365	Orchard grass	2,390
Mammoth clover	2,375	Timothy grass	2,800
Alsike clover	2,065	Red top grass	2,350
Alfalfa (first cut)	4,080	Meadow fescue	1,875
Blue grass	2,875	Tall meadow oat grass	3,000

Time of harvesting alfalfa, J. W. SANBORN (*Utah Sta. Bul. 31, pp. 1–7*).—A field of alfalfa was divided into 6 plats and 3 crops cut and cured for hay, that on different plats being cut before blooming,

when in bloom, and soon after blooming, respectively. The hay from the first and second cuttings at different stages was fed to cattle from December 20 to February 21. As shown by the gains in weight "the earliest cut alfalfa, both of the first and second crops, did better than the latest cut, while for the second crop the result was almost identical, whether it was cut early or cut at a medium period [in bloom]. . . . The late cut alfalfa in 2 crops gave as large a yield as when cut early and 3 crops taken. The only advantage that occurred from cutting 3 crops was the superiority in its nutritive effect. That medium cut, or cut at bloom, also yielded as much as when cut early. . . . On the whole, the balance of effect is favorable to the early cutting, due to the superior nutritive effect."

Crimson (or scarlet) clover, E. B. VOORHEES (*New Jersey Stas. Bul. 100, pp. 31*).

Synopsis.—A study of the composition of tops, stubble, and roots at different stages of growth, and a discussion of the value of crimson clover for green manuring, for pasturage, and for soiling. The roots attained practically their full weight April 24, when the plants were only 6 in. high, subsequent growth being made almost entirely by the tops. A crop 6 in. high, April 24, contained in the entire plant 103.7 lbs. of nitrogen per acre; 13 in. high, May 12, 168.3 lbs.; in bloom, May 24, 189.6 lbs.; and fully matured, May 31, 212 lbs. April 24 the digestible matter in the tops amounted to 1,310 lbs.; the crop cut May 12, 24, and 31 averaged 2,834 lbs. of digestible matter per acre.

Samples of the tops, stubble, and roots to a depth of 8 in. were taken from 3 fields of crimson clover, 2 being in Middlesex County and 1 in Gloucester County. These samples were taken at 4 stages of growth: (1) April 24, when the plants were 5 to 7 in. high; (2) May 12, when 12 to 14 in. high; (3) May 24, when in bloom and 22 to 28 in. high; and (4) May 31, when fully matured. In the sample taken at the earliest date tops and stubble were not estimated separately. To determine the relation between weights of tops, stubble, and roots areas of 1 sq. ft. were used; to determine acreage yield 1 sq. rod was used, the average weights per acre calculated from the larger area being 60.34 per cent of those from the smaller area.

Number of plants per square foot (p. 7).—This varied from 18 to 86, though in every case the stand was considered good, the plants when thin stooling abundantly.

Percentages of the total dry matter of the plants in tops, stubble, and roots (p. 10).—Averaging the results from the different farms the tops contained 67.3 per cent of the total dry matter of the plant April 24; 68.4 per cent May 12; 76.3 per cent May 24, and 82.6 per cent May 31. The stubble contained 11 per cent of the total dry matter May 12; 8.3 per cent May 24, and 6.1 per cent May 31. The roots contained 32.7 per cent of the total dry matter April 24; 20.7 per cent May 12; 15.4 per cent May 24, and 11.3 per cent May 31.

Composition of the dry matter of tops, stubble, and roots (pp. 11–14).—

The following table shows the nitrogen, phosphoric acid, and potash in the dry matter of tops, stubble, and roots of crimson clover:

Fertilizing constituents in dry matter of tops, stubble, and roots.

	Nitrogen.			Phosphoric acid.			Potash.		
	Tops.	Stubble.	Roots.	Tops.	Stubble.	Roots.	Tops.	Stubble.	Roots.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
April 24	3.66	....	2.61	0.85	....	0.87	3.01	....	1.81
May 12	3.73	2.03	2.91	1.02	0.76	0.99	3.17	2.66	1.18
May 24	3.05	1.94	2.74	0.72	0.49	0.76	1.91	1.13	0.82
May 31	2.82	1.95	2.73	0.67	0.52	0.87	2.54	2.88	1.45

Proximate analyses showed that the food constituents were not widely different April 24 and May 12, but that after the latter date there was a decided increase in fiber and a consequent decrease in the percentages of the other constituents. It is notable that in the tops the albuminoids were relatively greatest in the immature plant, the albuminoid nitrogen constituting 80.5 per cent of the total nitrogen April 24, but only from 69.4 to 72 per cent at later dates.

Value of crimson clover as a green manure (pp. 14–23).—The following table gives the average weights of green clover, dry matter, nitrogen, phosphoric acid, and potash afforded by an acre of crimson clover cut at different stages:

Yield per acre of green clover, dry matter, nitrogen, phosphoric acid, and potash.

Date of taking samples.	State of maturity.	In—	Green clover.	Total dry matter.	Nitrogen.	Phosphoric acid.	Potash.
			Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
April 24	5 to 7 in. high	Tops	21,048	2,040	74.6	17.2	61.4
		Roots	....	992	29.1	8.6	18.0
		Total	....	3,032	103.7	25.8	79.4
May 12	12 to 14 in. high	Tops	31,526	3,415	127.3	34.6	108.1
		Stubble	....	547	11.0	1.3	13.9
		Roots	....	1,031	30.0	10.1	12.1
		Total	....	4,992	168.3	46.0	134.1
May 24	In bloom	Tops	31,498	4,967	151.7	35.5	94.6
		Stubble	....	548	10.4	2.6	6.1
		Roots	....	1,004	27.5	7.5	8.1
		Total	....	6,519	189.6	45.6	108.8
May 31	Fully matured	Tops	37,976	6,356	179.2	42.5	160.4
		Stubble	....	469	9.1	2.4	13.5
		Roots	....	870	23.7	7.0	12.6
		Total	....	7,695	212.0	51.9	186.5

"The table shows that by far the largest amount of organic matter and plant food is contained in the tops, even at the first cutting, when the plants were 6 in. high, and that there is practically no increase in the organic matter and fertilizer constituents contained in the roots after that time. . . .

"The gain of organic matter and fertilizer constituents in the tops, including stubble, constantly increased until maturity. On April 24, roughly, two thirds of the

total plant food was contained in the tops; on May 12 the proportion had increased to five sixths, on May 24 to seven eighths, and on May 31 to nine tenths.

"These points are important in showing (1) that no good grounds exist for the statements so frequently heard that there is as much fertilizing value in the roots of a clover crop as in the tops; and (2) that as a green manure this plant increases in value up to the time of maturity. . . .

"Assuming that the entire amount of nitrogen contained in the whole crop represents a distinct gain to the soil, the crop harvested on April 24 added 103.7 lbs., an amount of nitrogen equivalent to that contained in 648 lbs. of nitrate of soda, which would cost, at present prices, in quantity, $15, or to the amount contained in 10 tons of average-quality manure. . . .

"The crop cut May 12 contained nitrogen equivalent to that contained in 17 tons of manure, and worth $25.50 per acre. . . . The average of the matured crops on May 24 and 31 contained per acre 200 lbs. of nitrogen and 6,500 lbs. of organic matter, or equivalent to that contained in 20 tons of city manure, which would cost in that form $30."

Value of crimson clover for pasturage and for soiling (pp. 23–31).—Crimson clover cut April 24, at which time it was suitable for early grazing, afforded the following amounts of digestible matter per acre: Fat, 50 lbs.; protein, 327 lbs.; carbohydrates, including fiber, 933 lbs., or a total of 1,310 lbs.

The cuttings made May 12, 24, and 31 were suitable for soiling, and the average quantities of digestible matter per acre afforded by these cuttings were as follows: Fat, 80 lbs.; fiber, 610 lbs.; protein, 658 lbs., and carbohydrates, 1,486 lbs. This gives a total of 2,834 lbs. of digestible matter grown on 1 acre, an amount which, "on the basis of 15.4 lbs. of digestible organic matter per 1,000 lbs. live weight, is sufficient to feed 10 cows in full flow of milk for 20 days."

Experiments with corn in 1893, D. N. BARROW (*Louisiana Stas. Bul. 28, 2d ser., pp. 962–966*).—These consisted of experiments with fertilizers and with varieties. On account of a drought in July the results with fertilizers are not reported. In the test of 3 varieties of corn from foreign countries, 7 from Northern States, 17 from Western States, and 10 from Southern States, Mosby Prolific, a late Southern variety, gave the largest yield, 74.3 bu. per acre. This was followed by Improved Leaming, an early variety from the West. Varieties maturing at intermediate dates were injured by drought.

Experiments with cotton in 1893, D. N. BARROW (*Louisiana Stas. Bul. 28, 2d ser., pp. 966–969*).—These embrace tests of varieties, of fertilizers, and of distance. Of 41 varieties tested, the largest yield of lint, 732 lbs. per acre, was made by Hawkins Improved; next in order of yield were Southern Hope, Peterkin New Cluster, and Hunnicutt. The largest proportion of lint to seed cotton, 37 per cent, was afforded by Bolivar County. The results of the fertilizer test are not reported, on account of injury from drought.

Distance experiments were made on land unfertilized for 4 years. The rows were 3, 4, or 5 ft. apart; the distance in the drill 1, 1½, or 2 ft.; and the plants were grown singly and two in a place on different plats.

The name of the variety is not given. The following table gives the results:

Effect of distance on yield of cotton.

Width of row.	Distance in row.	Stalks in hill.	Seed cotton per acre. First picking.	Second picking.	Third picking.	Total.
	Feet.	*Number.*	*Per cent.*	*Per cent.*	*Per cent.*	*Pounds.*
3 ft	1	1	54	36	10	1,726
3 ft	1	2	46	42	12	1,584
3 ft	1½	1	52	33	15	2,037
3 ft	1½	2	60	31	9	1,565
3 ft	2	1	62	30	8	1,811
3 ft	2	2	55	30	15	2,207
Average for 3-ft. rows						1,821
4 ft	1	1	62	30	8	1,715
4 ft	1	2	65	28	7	1,602
4 ft	1½	1	66	26	8	1,734
4 ft	1½	2	67	26	7	1,734
4 ft	2	1	58	31	11	1,432
4 ft	2	2	58	32	10	1,677
Average for 4-ft. rows						1,557
5 ft	1	1	61	33	6	1,624
5 ft	1	2	54	38	8	1,394
5 ft	1½	1	62	29	9	1,372
5 ft	1½	2	61	32	7	1,512
5 ft	2	1	51	43	6	1,428
5 ft	2	2	53	39	8	1,610
Average for 5-ft. rows						1,540

A report on uncultivated bast fibers of the United States, C. R. DODGE (*U. S. Dept. Agr., Fiber Investigations Rpt. 6, pp. 54, pls. 5*).—The most important plants and fibers treated are the following: Swamp rose mallow (*Hibiscus moscheutos*), rozelle hemp plant (*H. sabdariffa*), "Cæsar weed" (*Urena lobata*), sida fiber (*Sida rhombifolia*), cotton-stalk fiber (*Gossypium herbaceum*), hemp-like hibiscus (*H. cannabinus*), okra fiber (*Abelmoschus esculentus*), abutilon fiber (*Abutilon avicennæ*), asclepias, or milkweed fiber (*Asclepias incarnata* and *A. cornuti*), vegetable silk from the milkweed, Colorado River hemp (*Sesbania macrocarpa*), sunn hemp (*Crotalaria juncea*), Indian hemp (*Apocynum cannabinum*), stinging nettle (*Urtica gracilis*), common burdock (*Arctium lappa*), tree basts, and other fibers of plants of less prominence.

"The fiber of the cotton stalk possesses fair strength, specimens I have examined by hand tests appearing somewhat stronger than jute. The fiber of old stalks that have stood in the field is of varying shades of russet in color, while that from fresh stalks is a yellow white."

However, the author does not consider the cotton stalk as an economical source of fiber.

"In color okra fiber is as white as New Zealand flax, much lighter than jute as usually prepared for export, but more brittle and showing less strength. The filaments are smooth and lustrous and are tolerably regular. . . . Okra fiber is not only inferior to that from other species of mallows, but is inferior to jute, and not half as strong as hemp."

The author concludes that the cultivation of the okra plant for its fiber can not be made a paying industry in the United States.

The common white Indian mallow affords strong glossy white fibers.

"Undoubtedly *Asclepias incarnata* promises better results than any of the indigenous species of bast fibers in the United States that we have considered. If it will thrive upon waste lands, where no other crops will grow, it has to that extent an advantage over hemp, considering the strength of the fiber as fully equal to hemp. . . . As to the value of the fiber in manufacture, I can make no positive statements further than that samples of binding twine examined were found to be strong and good. As the fiber resembles hemp, there is little doubt that it could be employed in all uses to which hemp may be applied."

The author thinks favorably of Colorado River hemp, on account of its growing over vast areas without cultivation and producing a large yield. The fiber of common burdock was found to be very inferior.

Potatoes, L. R. TAFT and R. J. CORYELL (*Michigan Sta. Bul. 108, pp. 29–38*).—Notes on the culture of potatoes and a test of 174 varieties. For southern Michigan either early planting in April or late planting in June is recommended, since potatoes planted in either of these months are more apt to escape injury from drought than when planting occurs at intermediate dates. For late planting the late varieties are preferred.

Summit was the most productive variety grown. The author's list of well-tried varieties known to be reliable is as follows: Very early—Early Six Weeks, Market Gardener Early, and June Eating; early—Early Oxford, Lee Favorite, McFadden Earliest, Queen, and Paris Rose; medium—Chautauqua, Early Pearl, Fillbasket, Freeman, Nott Victor, Queen of Paris, Signal, Supplanter, Rural Blush, and Thorburn; late—American Wonder, Dakota Red, Halo of Dakota, President Lincoln, Rural New Yorker No. 2, and Summit. The more promising new varieties were Columbian Rose, Early May, Stoneroad Main Crop Nos. 1 and 2, Early Norther, Vaughan White Prize, World's Fair, and Wolverine Beauty.

Fertilizer tests with potatoes, L. R. TAFT and R. J. CORYELL (*Michigan Sta. Bul. 108, pp. 45, 46*).—Tabulated data giving yields of 3 varieties differently fertilized for 1891, 1892, and 1893. When the fertilizer was applied above the potatoes the yield was generally small, which fact the authors attribute to the lack of sufficient moisture to dissolve it.

The effect of season and of fertilizers on the yield and composition of rye, M. FISCHER (*Ber. physiol. Lab. landw. Inst. Univ. Halle, 10, p. 34; abs. in Centbl. agr. Chem., 23 (1894), No. 6, pp. 368–372*).—The author's experiments covered 5 years, from 1886 to 1890, inclusive. Each plat received annually the same fertilizer, consisting of either stable manure or phosphates, potash salts and nitrogenous fertilizers alone or combined. One plat remained unmanured throughout. From analyses of the crops raised it appears that the nitrogen-free extract and the fat were influenced by the weather to a greater extent than by the character of the manuring. Warm, sunny weather, with considerable moisture during the development of the grain, favored the formation of

nitrogen-free extract. This constituent was low in the years when the fat content was high. Stable manure and nitrogenous fertilizers increased the percentage of fat.

A luxuriant growth of straw, whether caused by weather or by manuring, was accompanied by a low percentage of nitrogen in the grain. Manuring with non-nitrogenous minerals also reduced the percentage of nitrogen. Rye grown on the unmanured plat was rich in this element.

Generally, the proportion of the total nitrogen existing as albuminoids rose or fell with the rise or fall of the ash, being greatest when only non-nitrogenous fertilizers were used and least when only nitrogenous minerals were applied. When the grain was light the proportion of crude protein existing in an indigestible form was high. A complete fertilizer tended to increase the proportion of the total nitrogen which was digestible.

Experiments in the culture of the sugar beet in Nebraska, H. H. NICHOLSON and E. E. NICHOLSON (*Nebraska Sta. Bul. 36, pp. 185–206, pl. 1, dgms. 3*).—Analyses of beets at different stages of growth; descriptions of the methods of culture, of growing improved seed, and of selecting mother beets; fertilizer experiments; distance experiments; a test of the effect on germination of soaking beet seed in different solutions; a comparison of the quality and quantity of the product resulting from large and small seeds and from light and heavy seeds; changes in the composition of the beet during growth; the propagation of beets from buds; and statistics concerning the beet-sugar industry in Nebraska. The fertilizer experiment gave unsatisfactory results. Rows 18 in. apart gave a larger yield and of slightly better quality than rows 15 and 24 in. apart. The germination experiment was vitiated by inopportune rains. Large seed gave a heavier yield and higher sugar content than small seed, and heavy seed, *i. e.*, seed which sank in kerosene oil, gave a larger sugar content and higher purity than light seed. The crown of the beet was found to bear to the entire root the ratio of 1:4. The difference in sugar content between the crown and body was only 1.75 per cent in 1892 and 1 per cent in 1893 in favor of the body, results which indicate the possibility of profitably using both the crowns and bodies of beets for sugar, especially in a dry season.

Tobacco experiments in 1891, 1892, and 1893, H. J. PATTERSON (*Maryland Sta. Bul. 26, pp. 57–94*).—A test of varieties of tobacco, of different barns for curing, coöperative fertilizer experiments, and a study of the effect of fertilizers on the composition and on the burning qualities of tobacco.

Twenty-nine varieties were grown, the yields of which are not given. "None of the improved or imported varieties have given any greater yields or proved to be as well adapted to Maryland . . . as have the varieties commonly grown in the State."

A frame barn was used for air curing; a log barn, modeled after the common log barn of North Carolina, and a sheathed frame barn were used for flue curing. "The results of experiments in curing, so far, have in a measure been unsatisfactory. . . . The frame barn produced decidedly more of the thoroughly cured tobacco than the log barn," in both of which flue curing was used. The temperature and degree of humidity for the 3 barns during curing are tabulated.

"These tables show that the humidity in the frame barn was almost always higher than that in the log barn, and on comparing these figures with the humidities obtained in one other case on record we can with reasonable certainty attribute the greater quantity of tobacco, well cured, in the frame barn to the humidity conditions being more favorable in that barn for the yellowing and fermentation process."

Fertilizer experiments conducted in a number of localities in the State in 1891 and 1892 are discussed, but in only one case were the crops on different plats harvested and cured separately. In this last experiment, made in Montgomery County in 1892, phosphoric acid increased the yield on every plat to which it was applied.

The author draws the following deductions from the results of numerous analyses of tobacco grown in different parts of the State and differently fertilized:

"The composition of the tobacco from the different sections varies considerably, especially as to the ash content.

"As a rule, other things being equal, the tobacco from the sections giving a high ash content also possesses a good burning quality.

"Chlorin, potash, magnesia, and lime vary considerably in the tobaccos from the different sections and in the tobacco differently fertilized from the same section.

"The other ash constituents remain fairly constant in tobaccos differently fertilized from the same section.

"Potash, lime, and magnesia seem able to replace each other to a limited extent.

"Burning qualities do not bear any close relation to the amount of woody matter or crude fiber present.

"There is no constant relation between the potash and chlorin content of tobacco possessing good burning qualities nor between the sum of the potash, lime, and magnesia, and the chlorin.

"A high per cent of chlorin is always accompanied with a poor burning quality.

"When the ash of tobacco possesses a high alkalinity it almost always possesses a good burning quality.

"Muriate of potash should not be used as a fertilizer, as it always produces tobacco with a poor burning quality and a bad ash.

"Sulphate of potash produced a better burning tobacco than any other of the potash salts.

"Lime and magnesia compounds, including the sulphate of potash and magnesia (low grade sulphates), in most cases produced tobacco of a poor burning quality.

"Phosphoric acid did not prove harmful to the burning qualities.

"The complete commercial fertilizer and the yard manure produced tobaccos with about the same burning qualities, and in most cases they produced a better burning tobacco than where no fertilizer was used."

The effects of muriate of potash and of sulphate of potash on the burning qualities of 18 varieties are recorded.

Fertilizer experiments with wheat, corn, and oats, C. E. THORNE and J. F. HICKMAN (*Ohio Sta. Bul. 53, pp. 1–30, 32, 33*).

Synopsis.—Experiments in fertilizing wheat, oats, and corn grown continuously and in rotation with timothy and clover at Columbus, and in fertilizing corn in Columbiana, Butler, and Washington counties. At present current prices for grains and fertilizers, the use of commercial fertilizers and even of barnyard manure (if valued on the same basis as commercial fertilizers) on wheat, oats, and corn was not profitable, except when these crops were grown in a systematic rotation with clover or a similar nitrogen-collecting crop. The poorer the soil the smaller the probability of profitable crop production by means of artificial fertilizers.

These experiments cover 5 years' continuous culture of wheat and oats at Columbus, 6 years' continuous culture of corn at Columbus and in Columbiana County, and 3 to 5 years' intermittent culture of corn in Washington and Butler counties; 3 years' culture of wheat and oats and 4 years' culture of corn, in rotation with clover and timothy.

Continuous culture of wheat, oats, and corn at Columbus (pp. 1–14).—For each of the crops grown continuously on the same land 22 twentieth-acre plats laid out on tile-drained land of uniform character were used. The fertilizers used per acre were 320 lbs. of dissolved boneblack; 320 lbs. of dissolved South Carolina rock; 300 lbs. of basic slag; 80 lbs. of muriate of potash; 160, 320, and 480 lbs. of nitrate of soda; 120 lbs. of sulphate of ammonia; 1,000 lbs. of linseed meal; and 8 tons of barnyard manure, alone or in combination.

The greatest increase in the yield of wheat over no fertilizer, 5.6 bu. per acre as the average of 5 years, resulted from the use of linseed meal; the average increase for all fertilizers was 3.3 bu. per acre. Phosphoric acid in the presence of potash and nitrogen, especially in the form of dissolved boneblack, largely increased the yield of straw.

With wheat at 80 cts. per bu., straw at $3 per ton, and barnyard manure at 50 cts. per ton every fertilizer was used at a loss except barnyard manure, with which the net gain was only $1.35 per acre.

With oats grown continuously on the same land the average increased yield due to fertilizers was 4.4 bu. per acre. The gains in yield where nitrogen, phosphoric acid, or potash was used were apparently identical, and no combination of these proved notably superior to their separate use. "The explanation of this is partly to be found in the fact that the oat plant does not find in the climate of southern Ohio the conditions suited to its normal development."

With corn the average increase due to fertilizers was 3.8 bu. per acre. Neither potash nor phosphoric acid, alone or combined, was beneficial, but nitrogen gave a small increase in the yield of grain and of stover.

Rotative cropping at Columbus (pp. 14–21).—The yields of wheat, oats, corn, clover, and timothy grown in a 5-crop rotation on plats differently fertilized are tabulated and published as a report of progress. Comparing the average yields for 1891, 1892, and 1893 of the rotation plats with those of the plats devoted to continuous culture of one crop, the gain due to rotation was, for wheat, 5.6 bu. per acre.

"[On oats grown on the rotation plats] apparently the application of phosphoric acid and potash, either directly or to the preceding crop of corn, is of considerable advantage, while the use of nitrogenous manures has been of doubtful benefit; but it is evidently unsafe to draw any general conclusions as yet from these experiments.

"[The results of the rotation experiment], so far as they go, support the general and reasonable belief that a large part of the benefit from commercial or other manures is to be realized in the crops not directly fertilized, in a well-planned rotation."

Experiments on corn in Columbiana, Washington, and Butler counties (pp. 21-30).—In Columbiana County, in a 6 years' test on the same plats, "both chemical fertilizers and barnyard manure utterly failed to maintain the land in a profitable state of productiveness." In Butler County the test was continued for 4 years, using a different field each year. "Potash seemed to produce exceptionally good results, but no form of chemical manures has equaled barnyard manure in the average increase." In Washington County the test covered 3 years, using a different field each year. The largest average increase, 17.4 bu. per acre, resulted from the use of a complete fertilizer.

Late crops for overflow lands, R. L. BENNETT and G. B. IRBY (*Arkansas Sta. Bul. 27, pp. 53-61*).—Notes on German millet, black Russian oats, white dwarf navy beans, sweet potatoes, cowpeas, Japanese buckwheat, and 5 varieties of corn planted on river-bottom land early in July. German millet yielded 3,428 lbs. of hay per acre; the young oat plants died; navy beans yielded 950 lbs. of beans per acre; sweet potatoes made but few roots; cowpeas yielded 758.3 lbs. of unshelled peas; buckwheat grew 3 ft. high. The variety of corn ripening first was Pride of the North; that making the largest yield, 59.4 bu. per acre, was White Giant Normandy.

The depth of the root crown of small grains as governed by depth of seeding, moisture, light, heat, and size of seed, P. KOSSOWITSCH (*Forsch. Geb. agr. Phys., 17 (1894), No. 1 and 2, pp. 104-116*).—To determine more exactly the connection between winterkilling and shallow crown formation, the author took measures of 900 living plants and of 900 which had been winterkilled from 3 different fields, in all of which, after the disappearance of snow in the spring, yellow dead plants were found among the green ones. On the 3 fields the killed plants had crowns 0.272, 0.396, and 0.334 in., respectively, below the surface. The living plants on the same field had crowns 0.672, 0.564, and 0.524 in. deep. The method used in this investigation presupposes that in this case winterkilling resulted directly from cold and not from heaving.

In the autumn of 1890 pot experiments were begun with wheat and rye to determine the depth of the crown resulting from sowing seed 0.6, 1.2, 2.4, 3.2, or 4 in. deep and from keeping the soil saturated, or supplied with $\frac{4}{5}$, $\frac{3}{5}$, $\frac{2}{5}$, or $\frac{1}{5}$ of the amount of water required for saturation. Rye formed a crown 0.6 to 1 in. below the surface and the depth was apparently unaffected either by the depth of seeding or by the

degree of soil moisture. With wheat the amount of moisture in the soil did not influence the depth at which the crown was formed, but deep planting increased this depth. Seed planted 4 in. deep generally formed a crown 1.4 in. below the surface; seed planted 0.6 in. deep, 0.6 below the surface. In the second series of experiments conducted by the author in 1891, seeding at depths of 2.4 and 1.2 in. afforded, respectively, crowns at depths of 1.212 and 0.748 in. Eckert and Stössner had previously shown the relation between the depth of seeding and that of crown formation in wheat. The experiments of these investigators on rye, oats, and barley gave conflicting results, due, as the author believes, to external influences which had not at that time been investigated.

S. Toporkow had observed that the deeper the seeding the deeper the crown in open fields, but with wheat plants shaded by trees the more shallow the seeding the deeper the crown. He found that plants growing in open fields formed the crown at greater depths than those in shady situations. By comparing the yields of wheat following cloudy and sunny autumns he obtained results that suggested, but in the nature of the case could not prove, that even in farm practice the difference in the amount of light under whose influence young wheat plants come up may affect their hardiness as regards winterkilling.

The author grew plants of winter wheat in pots in a dark corner of a room and the crowns were superficial. In other pot experiments in the open, plants very slightly shaded during early growth formed crowns 0.808 in. deep, while with check plants fully exposed the depth was 1.212 in.

In soil artificially kept at a temperature of 68° F., which was considerably higher than that of the atmosphere, crown formation was superficial. This was attributed to the rapid growth by which, in attaining a given height, the plants had been exposed to but a small amount of sunshine.

In the author's experiments small grains, weighing 26 mg., formed crowns at a depth of 1.16 in.; large seed, weighing 49 mg., at a depth of 0.96 in. Here the crowns resulting from small seed were deeper than those from large seed, thus conflicting with the results of Toporkow, who had obtained the deepest crowns from the largest seed.

For resistance to winterkilling a depth of 2 to 3.2 in. is recommended for seed sown early in the fall, for then clearer weather and longer days prevail than later. For later fall seeding, also for northern exposure, the depth should be less, thus insuring more rapid vegetation.

Roots of farm crops, J. W. SANBORN (*Utah Sta. Bul. 32, pp. 1–6*).—The weight of water-free roots of oats, barley, wheat, timothy, corn, potatoes, and clover in every inch of soil to a depth of 12 in. was determined by driving into the ground an iron frame inclosing 4 sq. ft., and provided with a horizontal slide by which sections of soil could be cut, and then separating the roots by sifting the soil through a series of sieves.

"The soil [in which the plants were grown] was a sandy loam, upper bench, and several feet deep at the point tried, to the cemented limey subsoil filtered into gravel." With oats, barley, wheat, and timothy duplicate tests were made, in other cases only one determination.

The following table gives the results in condensed form:

Dry matter of roots in an acre of soil, by inches.

	Oats.	Barley.	Wheat.	Timothy.	Corn cultivated.	Corn not cultivated.	Potatoes.	Clover 4 years old.	Clover 2 years old.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
First inch	38.47	33.60	41.28	541.68	17.28	15.06	4.56	1,058.40	270.72
Second inch	524.30	81.12	84.48	279.84	45.60	57.60	6.72	1,248.48	449.28
Third inch	531.60	84.48	99.12	116.88	94.80	86.40	6.00	1,181.04	433.92
Fourth inch	415.20	63.60	135.60	103.92	168.96	156.00	5.52	1,142.40	170.88
Fifth inch	173.28	49.20	64.80	89.76	62.64	54.44	7.20	508.80	149.28
Sixth inch	128.88	30.00	28.32	38.40	38.88	43.20	4.80	124.80	137.52
Seventh inch	17.28	6.96	11.52	24.00	16.80	9.36	22.08	88.80	....
Eighth inch	15.12	5.52	5.76	26.88	8.64	8.40	12.24	66.24	....
Ninth inch	13.92	6.72	6.24	29.94	7.68	4.56	15.60	62.16	....
Tenth inch	12.48	5.76	6.00	24.00	5.04	3.60	8.40	50.40	....
Eleventh inch	14.16	5.28	6.00	16.56	5.76	3.66	14.64	50.16	....
Twelfth inch	11.76	3.84	3.60	12.00	6.00	2.40	12.24	48.48	....
Total	1,888.45	376.08	492.72	1,003.86	480.08	466.22	120.00	5,630.16	[1] 1,481.60

[1] First 6 in.

"Oats gave the greatest weight [of roots] at 3 in. deep. The weight for the first inch was very small; after passing the fourth inch the weight of the roots decreased very rapidly, the total having for the 8 in. below the upper 4 in. less than the amount in the third inch.

"The weight of roots for the clover was greatest for the first 4 in., after which it decreased with great rapidity until it reached the seventh inch, when it amounted to only 82 lbs., decreasing until the twelfth inch, when it was only 4 lbs. per acre.

"For corn the greatest weight of roots was found at the depth of 4 in., being more for this depth than for the 8 in. that succeeded it, and just about equal to the amount in the preceding 3 in. For the corn on the uncultivated area, we do not find any variation in weight of roots that we can trace to the influence of tillage. . . .

"The weight of the roots of potatoes [exclusive of tubers] is surprisingly small and quite unlike that of any other crop. It seems that they increased in weight variably until down to the depth of 7 in., when the decrease was comparatively slow, the weight even at 12 in. deep being comparatively high, or more than in any other inch up to the seventh inch in depth. . . .

"Timothy gives us a surprise second only to that for clover. The greatest weight of roots was found in the first inch, and the decrease was constant to the depth of 12 in. We may infer from these figures that manure applied to timothy would not necessarily have to be put in at great depth. . . .

"Barley gives its greatest weight of roots for the depth of 3 in., after which the decrease is constant to the twelfth inch. The weight of the roots of barley is very much less than that of oats.

"Wheat shows the greatest weight of roots at the fourth inch, after which the decrease is rapid. It has usually been understood that wheat is a more deeply rooted plant than either oats or barley.

"Clover 2 years of age gave less than half the weight of roots that the lot 4 years of age gave. This may be in part due to the plat upon which it is grown."

Number of plants and stalks of farm crops per acre, J. W. SANBORN (*Utah Sta. Bul. 32, pp. 7–9*).—For each crop four counts were made,

using each time an area of 4 sq. ft. The crops grown were considered average crops, the yield of clover, for example, being 2 tons per acre. The result of this enumeration is given below:

Number of plants and stalks of oats, barley, spring wheat, fall wheat, rye, and clover on 1 sq. ft. and on 1 acre.

	Number of plants per sq. ft.	Number of stalks per sq. ft.	Number of plants per acre.	Number of stalks per acre.
Oats	28.55	29.90	1,243,638	1,301,355
Barley	23.40	37.70	1,018,215	1,644,390
Spring wheat	8.12	34.40	353,925	1,497,375
Fall wheat	12.55	35.12	546,678	1,530,045
Rye	62.50	67.00	2,722,500	2,918,520
Clover	4.05	....	176,418	....

Corn, R. L. BENNETT and G. B. IRBY (*Arkansas Sta. Bul. 27, pp. 61–67*).—A record of the yield of 14 varieties and notes on the cultivation of corn. From tests made at Newport and Fayetteville the following varieties are recommended for all portions of the State: Late—Giant Normandy, Mammoth White, and Pride of America; medium—Champion Early White Pearl, Golden Beauty, and Leaming Yellow.

Cotton, R. L. BENNETT and G. B. IRBY (*Arkansas Sta. Bul. 27, pp. 70–72*).—Notes on the cultivation of cotton and on 2 varieties of Egyptian cotton, Bamiah and Afifi. Both Egyptian varieties proved unprofitable.

Cowpea hay, R. L. BENNETT and G. B. IRBY (*Arkansas Sta. Bul. 27, p. 78*).—A brief note on sun curing *vs.* curing in the shade. Analysis "revealed no practical difference in the 2 samples."

Forage plants, R. L. BENNETT and G. B. IRBY (*Arkansas Sta. Bul. 27, pp. 79–83*).—A statement of the yields made by white millo maize, Kaffir corn, yellow millo maize, pearl millet, early amber sorghum, Jerusalem corn, teosinte, and oats on sandy loam soil.

Forage plants, D. N. BARROW (*Louisiana Stas. Bul. 28, 2d ser., pp. 971–974*).—Brief notes on Texas blue grass, alfalfa, bur clover, red clover, crimson clover, redtop, orchard grass, Kentucky blue grass, tall meadow oat grass, Italian rye grass, and meadow fescue grass, and a tabulated statement of the yields of peas and hay made by 12 varieties of cowpeas.

Experiments with commercial fertilizers on hemp, M. A. SCOVELL (*Kentucky Sta. Rpt. 1890, pp. 105–112*).—A reprint of Bulletin 27 of the station (E. S. R., 2, p. 145).

Lathyrus sylvestris, A. DAMSEAUX (*Bul. Mens. Soc. Sci. Agr. et Arts, Basse-Alsace, 28 (1894), No. 5, p. 178*).—A favorable experience in growing and feeding this plant. Cattle at first refused it, but mixed with other food learned to eat it. When ensiled the characteristic bitterness disappeared.

Experiments with oats, M. A. SCOVELL (*Kentucky Sta. Rpt. 1890, pp. 47–56*).—A reprint of Bulletin 23 of the station (E. S. R., 2, p. 21).

Peanuts, African ground pea, and chufa, D. N. BARROW (*Louisiana Stas. Bul. 28, 2d ser., pp. 971, 972*).—The yield of Spanish peanuts was at the rate of 4,422 lbs. of fresh nuts per acre. White and Virginia peanuts and chufas were also grown with success. The African ground pea was more successful than in former seasons.

Concerning the value of Polygonum sachalinense (*Bul. Mens. Soc. Sci. Agr. et Arts, Basse-Alsace, 28 (1894), No. 5, pp. 192–195*).—Notes on growth, with plates, of *Polygonum sachalinense* and *P. sieboldtii*.

Varieties of potatoes preferred by European markets, HEYNEMANN (*Mitt. deut. landw. Ges., 1894, No. 5, pp. 73–75*).

The preservation of potatoes, E. SCHRIBAUX (*Bul. Jour. Soc. Central d'Agr., Alpes-Maritimes, 34 (1894), No. 5, pp. 111–119*).—Directions for treating potatoes with a solution of sulphuric acid in order to preserve them.

Fertilizer experiments with the sugar beet, A. BRANDIN (*Jour. Agr. Prat., 158 (1894), No. 36, pp. 343–347*).

Beet sugar in California (*Cult. and Country Gent., 1894, Sept. 6, p. 647*).—A popular article on profits made by sugar-beet growers at Chino, California.

Sugar cane, D. N. BARROW (*Louisiana Stas. Bul. 28, 2d ser., p. 975*).—Analyses of the juice of 15 varieties of sugar cane, both plant cane and stubble.

The care of tobacco plants for seed (*Braunschw. landw. Ztg., 62 (1894), No. 24, pp. 106, 107*).—Before topping the crop the plants with the best leaves should be selected for seed. In order to have all the seed ripen at the same time it is recommended that only the first blooms be left, removing all the seed stems except the topmost; further, that no leaves be removed from the stalks selected for seed until the latter are ripe. The injury to the seed resulting from the removal of leaves is in proportion to the number of blooms allowed to stand, and is greater in cold, wet seasons, when the plants are late in reaching complete maturity, than in seasons more favorable to early ripening.

The weight of the individual seeds determines to a large extent their value, and the removal of leaves reduces the weight of the seeds. Ten thousand seeds growing on plants from which the leaves when ripe had been removed, weighed, when all blooms were allowed to mature, 0.78 gm.; when only 40 to 50 blooms per plant were retained, 0.82 gm. When the leaves were not removed 10,000 seeds weighed, when all blooms were left, 0.87 gm.; when only 40 to 50 blooms were retained, 0.86 gm.

The tobacco crop in Connecticut, S. B. KEACH (*Cult. and Country Gent., 1894, Aug. 9, p. 579*).

Experiments with fertilizers on tobacco, M. A. SCOVELL (*Kentucky Sta. Rpt. 1890, pp. 113–121*).—A reprint of Bulletin 28 of the station (E. S. R., 2, p. 225).

Tobacco and buckwheat, D. N. BARROW (*Louisiana Stas. Bul. 28, 2d ser., p. 974*).—A list of varieties of tobacco grown and an experiment with 2 varieties of buckwheat. Silver-hull buckwheat failed; the Japanese variety yielded 720 lbs. of grain per acre. Planted in April, both varieties ripened in 60 days.

Experiments with wheat, M. A. SCOVELL and C. L. CURTIS (*Kentucky Sta. Rpt. 1890, pp. 135–146*).—A reprint of Bulletin 30 of the station (E. S. R., 2, p. 227).

Experiments with varieties of wheat, F. DESPREZ (*Jour. Agr. Prat., 58 (1894), No. 35, pp. 321–323; No. 36, pp. 357, 358*).—A record of yields of wheat at the Cappelle (France) Experiment Station and notes on varieties.

Cacao drying (*Roy. Bot. Gard. Trinidad, Misc. Bul. 23, pp. 273, 274*).—Description of hot water apparatus for rapid drying of cacao.

Coffee culture in Honduras, J. J. PETERSON (*U. S. Consular Rpt., 1894, July, pp. 402–405*).

Liberian coffee (*Roy. Bot. Gard. Trinidad, Misc. Bul. 23, pp. 267–273*).—A report on the cultivation and preparation for market of this coffee.

Cultivation of flax in Holland, L. S. REQUE (*U. S. Consular Rpt., 1894, July, pp. 412–415*).

The cultivation of ginseng, H. TRIMBLE (*Amer. Jour. Pharm., 24 (1894), No. 8, pp. 399–401*).—Principally notes from practical growers.

Intensive cultivation of grain, G. CUGINI (*Ann. Soc. Agr. Bologna, 1894, pp. 45*).

Farm notes, C. L. INGERSOLL (*Nebraska Sta. Bul. 35, pp. 178–182, fig. 1*).—Tabulated data giving yield and cost per bushel for 2 varieties of spring wheat, 8 of oats, and 11 of corn; a general statement regarding detasseling corn; and notes on seeding to clover, on insects, fall crops, oats for forage, varieties of potatoes, and yield of sugar beets.

Rotation experiments, R. L. BENNETT and G. B. IRBY (*Arkansas Sta. Bul. 27, pp. 68–70*).—A record of the crops of cotton, corn, cowpeas, oats, and barley grown on 3 plats during 4 years.

Rotation of crops, D. N. BARROW (*Louisiana Stas. Bul. 28, 2d ser., pp. 969–970*).—Brief notes on rotation experiments for which results are not given.

Crops in Ontario, C. C. JAMES (*Ontario Bureau of Industries Bul. 50, pp. 7*).—A report on meteorological conditions and on the condition of wheat, barley, oats, rye, corn, buckwheat, beans, timothy, clover, roots, potatoes, bees and honey, and labor and wages.

HORTICULTURE.

Some recent Chinese vegetables, L. H. BAILEY (*New York Cornell Sta. Bul. 67, pp. 175–201, pls. 2, figs. 9*).

Synopsis.—Notes on the growing of 13 Chinese vegetables, most of which proved of but little value. The Chinese cabbage, Pe-Tsai, and preserving melon, Zit-kwa, were the most satisfactory.

In order to determine the value of Chinese vegetables for American gardens, the seeds of nearly every little-known variety grown by the Chinese in the vicinity of New York and Boston were procured, and the plants tested. With few exceptions they were found to be either crucifers or cucurbits.

Of the first the Chinese cabbage, Pe-Tsai (*Brassica pe-tsai*), gave the best results. It is an annual resembling Giant Cos lettuce, and the head is a long loose roll of soft leaves, the inner ones blanched and very crisp. An average head weighed 3 or 4 lbs. Cooked as cabbage it was milder and sweeter, and served raw, shredded with sugar and vinegar, was excellent. It required to be grown on a well-watered soil. The Pak Choi (*B. chinensis*) is a closely allied species with celery-like leaf stalks, and the roots frequently enlarge like turnips.

The "California pepper grass" (*B. japonica*) has been grown in America some time. It is a low, pretty plant, halfway between a cress and a mustard, and the leaves have a sharp taste. It was found to give a fine flavor to salads or garnishes. The Chinese mustard, or Choi toi (*B. juncea*), is more widely grown and was desirable for winter greens. The Chinese tuberous-rooted mustard (*B. napiformis*) has a conical root 3 or 4 in. in diameter, scarcely distinguishable from white turnips in appearance or flavor.

Of the cucurbits the Chinese preserving melon or Zit-kwa (*Benincasa cerifera*), which is also grown in India, and in San Francisco is known as "Chinese watermelon," has a vine resembling that of a hairy muskmelon, and an oblong solid fleshy fruit from 10 to 15 in. in length. It was not relished raw, but much liked in preserves or sweet pickles, and thought worthy of general cultivation. The La-kwa (*Momordica charantica*) is a vine bearing oblong tubercled fruit resembling a cucumber, inclosing many rounded scarlet masses of pulp, in the centers of which are the seeds. The fruit is gathered before it is ripe, and, either as

a whole or the rind and pulp separately, is mixed with various spices, etc., as a salad or pickle. The dish-cloth gourds, Sua-kwa (*Luffa cylindrica*) and Sing-kwa (*L. acutangula*), on account of the spongy fibrous interior when mature, are eaten before they are ripe, either sliced as cucumbers or cooked like squashes. The vines are cucumber-like, but the fruit may be from 2 to 9 ft in length. The fruit of Sua-kwa is smooth, but that of Sing-kwa is sharply 10-ridged.

Of the miscellaneous vegetables the Chinese pea, Ga-lon-ow, is an ancient type of our common species, *Pisum sativum*. The peas are small, and vary in color from nearly white to dark brown, but were found sweet and palatable. The darker seeds proved the earlier and bore rose-purple flowers, while the lighter later peas produced white blossoms. The Chinese bean, Tou-kok (*Dolichos sesquipedalis*), has slender few-seeded pods frequently 20 in. in length, and requires a long season so that it may prove of value as a late string bean. The bean is native to South America. The Hon-toi-moi (*Amarantus gangeticus*) is very closely allied to the American beet weed, and seems to be highly prized in China for greens. The Yon-soi is a variety of the common coriander (*Coriandrum sativum*), and the young leaves are relished by the Chinese as a condiment.

Very few of these vegetables are considered advantageous for American gardens, the Pe-Tsai, Zit-kwa, and Tou-kok being perhaps the best for introduction.

Variety tests of vegetables, L. R. TAFT, R. J. CORYELL, and H. P. GLADDEN (*Michigan Sta. Bul. 109, pp. 49–65*).—Descriptive notes and tabulated data for several kinds of vegetables, with remarks on the culture. There were tested 48 varieties of cabbage, 11 of cauliflower, 33 of sweet corn, 56 of peas, 33 of tomatoes, and several each of beans, celery, cucumbers, lettuce, and squashes. Nearly all were somewhat affected by the drought of midsummer, but the respective fitness of the varieties was fairly well established. Especial mention is made of the cultivation of celery and salsify, and the more general culture of the latter is advocated. The following varieties are recommended: *Cabbage*—Etampes, Lightning, Charleston Wakefield, Henderson Early Summer, All Seasons, Succession, Autumn King, and World Beater. *Cauliflower*—Snowball, Dwarf Erfurt, Seafoam, and Mont Blanc. *Sweet Corn*—White Cob Cory, Extra Early Vermont, Chicago Market, Stabler Early, Egyptian, Nonesuch, Gold Coin, and Country Gentleman. *Peas*—Extra Early, Maud S, Blue Beauty, Early May, Fill Basket, Heroine, Eugenie, Sutton Satisfaction, and Champion of England. *Beans*—Red Valentine, Cylinder, Black Wax, Mammoth Wax, Butter Wax, Dwarf Horticultural, Goddard Bush, Speckled Wax, Golden Cluster, Golden Champion, Horticultural Lima, and Warren. *Celery*—Golden Self-Blanching, White Plume, and Rose. *Cucumbers*—White Spine, Nordhook Improved White Spine, Russian, and Long Green. *Lettuce*—Black-Seeded Simpson, Hanson, Grand Rapids, Prize Head, Onondaga,

and Iceberg. *Squashes*—Summer Crook Neck, White Bush, Scallop, Boston Marrow, Hubbard Marblehead, and Delicata. *Tomatoes*—Earliest, Advance, Ignotum, Lorillard, and Optimus.

The list of preferred varieties varies somewhat from that previously given in Bulletin 90 of the station (E. S. R., 4, p. 827).

Bananas and plantains (*Kew Misc. Bul. 92, pp. 229–314*).—An elaborate descriptive and cultural bulletin treating of the various species of *Musa*, their botanical relationships, distribution, cultivation, and uses as food.

Species.—The genus *Musa* is indigenous to the Old World and Polynesia, but has been introduced into other warm countries. A synopsis and description of 35 species of *Musa* is given, with full technical descriptions and illustrations of many of the species. The genus is divided into 3 subgenera: *Physocaulis* (swollen-stemmed Musas), *Eumusa* (true Musas), and *Rhodochlamys* (red-bracteated Musas). The first comprises 7 species, 5 indigenous to Africa and 2 found in Asia. The fruit is not edible. The subgenus *Eumusa* contains 16 species, distributed in southeastern Asia and the Malay Archipelago and Pacific islands. The fruit is usually edible. Twelve species from southeastern Asia and adjoining islands make up the subgenus *Rhodochlamys*, the fruit of which is not as a rule edible. The more commonly cultivated species is *Musa sapientum*, with numerous varieties, including most of the common bananas and plantains of commerce. Perhaps next in extent of cultivation is *M. cavendishii*, the dwarf or Chinese banana; but *M. discolor*, with a violet pulp, *M. fehi*, and *M. maculata* are also grown for eating.

Cultivation.—Bananas require a moist and uniform heat. Many of them will grow in the shade of other trees, but require a deep, rich virgin soil containing plenty of vegetable mold. In the tropics the fruit-bearing stalks are annual, but in cooler countries, where they have a resting period during the winter, the stems may live for 2 or 3 years, in all cases, however, dying as soon as fruit is produced. They grow most luxuriantly in warm, moist valleys shut in by mountains, although they grow upon the mountain sides to an elevation of 3,000 to 4,000 ft. A mean annual temperature of 75 to 80° F. appears to suit them best.

They should be planted from 8 to 16 ft. apart in rows the same distance from each other. The plants should be frequently and abundantly supplied with fresh manure and well watered. But 3 stems should be allowed to each plant, and all suckers should be promptly removed. When a stem ceases fruiting it should be cut down, and a fresh sucker allowed to replace it. Since bananas and plantains require such a rich soil, the plantation should be changed every few years, as by that time the soil tends to wear out. Stable manure combined with sulphate of ammonia has proved the best fertilizer.

Uses.—The chief use of bananas is as a dessert fruit, for which they are usually employed raw. Plantains, on the other hand (*Musa sapien-*

tum paradisiaca), are unpalatable when raw, and must be roasted or boiled before being eaten. The inner undeveloped leaves and the flower buds are sometimes boiled and eaten like cabbage, or made into a curry. Of late interest has been taken in meal produced by drying and grinding or pounding bananas and plantains. This is said to be highly digestible and nutritious.

A palatable drink called "wine," "beer," or "cider" is made by treating crushed ripe bananas or plantains with water and allowing the mixture to stand for a few days. Recently bananas have been canned in the form of preserves, and they have also been successfully dried.

The fiber from the stems of various species of *Musa* has long been prized. In many parts of the tropics the scanty clothing of the natives is woven from banana fiber. The well-known manila hemp is produced from the fiber of *Musa textilis.* Other uses for banana fiber are being developed. The trade in bananas is rapidly growing, and is greater in the United States than in any other country. The taste for this luscious fruit seems to be on the increase, and as both bananas and plantains are singularly free from diseases, there appears to be a promising future for their cultivation.

Peas for tropical culture (*Roy. Bot. Gard. Trinidad, Misc. Bul. 23, p. 278*).—A report of the successful cultivation of Veitch Extra Early and Chelsea Gem varieties.

Black summer radishes, G. ALLUARD (*Rev. Hort., 66 (1894), No. 13, pp. 308, 309, figs. 3*).—Descriptive notes on a few varieties of radishes, with cultural remarks and figures of 3 varieties.

Cultivating onions in Egypt, F. C. PENFIELD (*U. S. Consular Rpt., 1894, July, pp. 399, 400*).

Yam culture (*Roy. Bot. Gard. Trinidad, Misc. Bul. 23, p. 275*).—A report on the cultivation of the water yam (*Dioscorea alata*), from which large returns are given.

The turnip (*Amer. Gard., 15 (1894), No. 20, p. 359*).—A popular account of its history and cultivation of the various varieties.

Vegetables in June (*Agl. Gaz. N. S. W., 5 (1894), No. 5, pp. 349–351*).—Notes on the care of some common garden vegetables in Australia during the month of June.

The kitchen garden, G. WYTHES (*Garden, 46 (1894), No. 1187, pp. 154, 155*).—Notes on the growing of various vegetables for private consumption.

Apple culture, A. H. BENSON (*Agl. Gaz. N. S. W., 5 (1894), No. 5, pp. 310–323, figs. 9; No. 6, pp. 391–409, figs. 16*).—A lengthy paper on the subject, treating of the origin and uses of the apple, planting, cultivating, manuring, harvesting, marketing, and insects and diseases, with treatment.

The apricot in California (*Cal. Fruit Grower, 15 (1894), No. 6, p. 102, fig. 1.*)—Some statistics on apricots grown in the United States, showing that California produces twenty nine thirtieths of the entire crop, and brief notes on the culture and varieties, St. Ambroise being preferred.

The curing of figs (*Cal. Fruit Grower, 15 (1894), No. 6, pp. 106, 107*).—Notes on fig-growing with directions for picking, sulphuring, sweating, drying, and packing.

Figs and their culture, J. CRAWFORD (*Garden, 46 (1894), No. 1186, pp. 132, 133*).—Notes on the growing of figs in England, with directions and suggestions. The varieties Brown Turkey, Saint John, Negro Largo, White Marseilles, Bourjassotte Grise, Castle Kennedy, Black and White Ischia, and Brunswick are recommended.

California oranges and lemons, J. WILLIS (*Gard. Chron., 16 (1894), ser. 3, pp. 229, 230*).—A reprint from California Station report, 1891–'92 (E. S. R., 5, p. 588).

Lemon-curing for market, A. MOLINEUX (*Garden and Field, 20 (1894), No. 12, p. 70*).—A general paper on the preparation of lemons for the market. The lemons should be carefully clipped off the trees when 2½ to 3 in. in diameter, even though green, and laid in trays under the trees for a week. They are next "sweated" by being placed close together in a cool, dry, ventilated room for from 48 to 60 hours, during which time they become yellow. They are then separated a little, and sulphur burned in the room to destroy fungus germs. Finally they are stored in a cool, dark, airy place, free from moisture, and gone over every few weeks to cull out any that may decay. In shipping, each lemon is wrapped in tissue paper and packed stem downwards, 50 lbs. (about 300 lemons) in a box.

Budding peaches (*Amer. Gard., 15 (1894), No. 20, pp. 354, 355, figs. 2*).—Directions for the proper budding of peach trees, mostly taken from Michigan Experiment Station bulletins.

West India fruits (*Roy. Bot. Gard. Trinidad, Misc. Bul. 23, pp. 280–282*).—Descriptions of Barbados cherry (*Malipighia punicifolia*) and the vegetable marrow (*Blighia sapida*).

Management of a young orchard, T. H. HOSKINS (*Amer. Gard., 15 (1894), No. 21, pp. 370, 371*).—A general descriptive discussion of the subject.

Barberries, F. L. SARGENT (*Pop. Sci. Monthly, 45 (1894), No. 5, pp. 594–608, figs. 12*).—A popular article on *Berberis* spp., giving the relationship, botanical characters, origin, and the history of their cultivation, with cultural remarks.

Some raspberry crosses, F. W. CARD (*Garden and Forest, 7 (1894), pp. 334–336*).—Gregg, Shaffer, Cuthbert, Fontenay, and Ada, each of a different species, were used for crossing, in some cases with good results. Systematic selection of varieties for crossing is advocated.

Seedlings from the Shaffer raspberry, S. B. GREEN (*Garden and Forest, 7 (1894), p. 319*).

Support for berry bushes (*Amer. Gard., 15 (1894), No. 20, p. 355, fig. 1*).—Illustrated description of an apparatus of posts and wires for keeping the fruiting branches off the ground.

Strawberries, J. MURRAY (*Kentucky Sta. Rpt. 1890, pp. 73–78*).—A reprint from Bulletin 25 of the station (E. S. R., 2, p. 22).

Strawberries, G. ALLUARD (*Rev. Hort., 66 (1894), No. 14, pp. 326–328, fig. 1*).—Remarks on the culture and hybridizing of strawberries, with descriptions of some new French varieties.

Strawberry forcing, G. WYTHES (*Garden, 46 (1894), No. 1186, pp. 134, 135*).—Notes on the preparation of pots and soil for the early forcing of strawberries and the care necessary. Of several varieties mentioned, Vicomtesse Héricart de Thury is preferred.

Midsummer among the small fruits, L. R. TAFT (*Amer. Agr., 1894, Aug., p. 420*).—Suggestions as to the summer care of raspberries, strawberries, currants, and gooseberries.

Espalier grape culture, A. BOURGNE (*Rev. Hort., 66 (1894), No. 15, pp. 349–351, figs. 2*).—Remarks on this kind of vine training, with details of its practice at Vaudreuil, France.

Raisin forcing houses, C. CRÉPEAUX (*Rev. Hort., 66 (1894), No. 13, pp. 303, 304*).—Descriptive article on establishments of the sort in Europe, with details of the methods employed.

Vine pruning, A. J. PERKINS (*Garden and Field, 20 (1894), No. 2, pp. 59–62, figs. 3*).—A discussion of the laws of pruning grapevines, and illustrated directions for their proper carrying out.

Composition of Sicilian grapes and wines of 1893, V. OLIVERI (*Staz. Sper. Agr. Ital., 26 (1894), No. 5, pp. 498–500*).—Analyses and notes.

Glass-houses for the tropics (*Roy. Bot. Gard. Trinidad, Misc. Bul. 23, pp. 279, 280*).—The necessity for greenhouses is pointed out, and hints for their construction given.

It is said to be impossible to get *Cinchona*, sugar cane, etc., to seed unless protected from the rain, winds, and extreme heat of the tropics.

The fringe tree (*Garden and Forest, 7 (1894), pp. 325, 326, fig. 1*).—Illustrated description of the American fringe tree (*Chionanthus*), and notes on it as an ornamental shrub.

Use of rose hips, P. HAUGUEL (*Rev. Hort. 66 (1894), No. 13, p. 303*).—Remarks on the value of the seed pods of *Rosa rugosa* for pickling, and in making astringent drinks for use in certain diseases.

Electricity in horticulture, H. C. FYFE (*Sci. Gos., 1894, Aug., pp. 124, 125*).—A brief résumé of the history of horticultural experiments with electricity, recounting the results.

The experimental laboratory of the National Horticultural School at Versailles, E. ANDRÉ (*Jour. Agr. Prat., 58 (1894), No. 35, pp. 311–314, figs. 4*).—A popular account of buildings and methods of experiment.

Fertilizers and their application, R. SIMPSON (*Amer. Florist, 10 (1894), No. 325, pp. 84–86*).—Relates principally to the use of fertilizers on ornamental plants, and is of a popular character.

FORESTRY.

Willows and their cultivation, E. J. BAILLIE (*Jour. Royal Agl. Soc. England, 5 (1894), No. 18, pp. 234–250*).—The classification of willows, both botanically and agriculturally, presents great difficulty. The author recommends the green willow (*Salix viminalis* var.) and the bitter osier (*S. kirksii*) for growing the large rods; for the smaller basket work the most suitable are the varieties of *S. caprea*, commonly known as purple willow, and yellow osier. A deep alluvial soil is the most suitable for a willow plantation. All stagnant surface water should be drained off, and the ground trenched to the depth of a foot or more. Cuttings 12 or 14 in. long from 2 year-old shoots should be used, and these should be inserted in the ground at least two thirds of their length. The cuttings are placed not over 20 in. apart each way, and it is most important that the "holt," as the plantation is called, should be kept clean from weeds, grasses, and undergrowth. Cutting may commence in late November or in December, and a sharp, short-bladed sickle is the best implement to employ, as its use diminishes the amount of split rods or torn bark. The rods should be cut off close to the base, leaving no spurs, so that the shoots of the succeeding season may come up strong from the roots. Frequently it may be desirable to let some part of the crop stand for the second year's growth to obtain larger rods.

As many as 75 species of lepidopterous larvæ are known to feed upon the leaves and wood of *Salix caprea* alone, and many beetles also; but insect attacks in this particular field of cultivation have not yet been so seriously harmful as to call for remedial measures. Spraying with suitable insecticides would probably be effective.

It is suggested that the growing of willows be carried out on sewage farms, the moisture and fertilizing elements recommending themselves for this purpose.

The cost of preparation, planting, cleaning, and harvesting during the first year, together with the purchase of cuttings, is estimated at about $125 per acre, the expenses in subsequent years, however, falling to $25 or $35 per acre. The yield in fair seasons is from 6 to 8 tons of willows, green weight, worth about $12 to $15 per ton.

The ginkgo tree, REYNOLDS (*Amer. Florist, 10 (1894), No. 323, p. 3*).—Description and recommendations for its more general planting in America.

The silver fir in Auvergne (*Garden, 46 (1894), No. 1187, p. 146*).—Note on the forests of this species and its timber value.

The removal of moss, J. GÉROME (*Rev. Hort., 66 (1894), No. 13, pp. 313–315, figs. 3*).—An article on the removal of moss from lawns and trees, with directions and figures of implements.

A yew wood, A. DIXON (*The Mayflower, 10 (1894), No. 8, p. 245*).—A popular account of yew forests in England and description of the trees.

The geographical distribution of forest trees, I—The Coniferæ, GRAUER (*Forstw. Centbl., 16 (1894), No. 8, pp. 377–409*).

Some trees from Rancho Chico, C. H. SHINN (*Garden and Forest, 7 (1894), p. 332*).—A descriptive list of the native and introduced trees to be found in this famous collection in northern California.

Good and bad planting (*Amer. Gard., 15 (1894), No. 20, p. 350, fig. 1*).—A popular illustrated article on the planting of trees, with the different methods described and figured.

Transplanting large trees (*Amer. Gard., 15 (1894), No. 21, p. 369, figs. 2*).—Notes and illustrated description of the proper method.

The wood and markings of the year's growth, I, E. JAHN (*Bot. Centbl., 59 (1894), No. 9 and 10, pp. 257–267*).

Observations on the occurrence and growth of the oak, WALTHER (*Ztschr. Forst- und Jagdw., 7 (1894), pp. 278-283*).

Summer operations in woodlands, A. D. WEBSTER (*Garden, 46 (1894), No. 1186, p. 140*).—Notes on the work in summer in English parks and woods. Careful mowing of the weeds is advised and trimming off undesirable branches with sharp blades, so that the wounds may heal during the summer growth. Directions are given for pruning and the planting of young trees.

Our timber trees and forest culture, W. MACDONALD (*Agl. Gaz. N. S. W., 5 (1894), No. 6, pp. 367–378*).—A paper on Australian forestry, decrying the destruction of valuable timber in various ways, and advising care and planting of trees, cultural suggestions being made.

Wind-breaks, F. H. KING (*Garden and Forest, 7 (1894), p. 359*).—A synopsis of a paper on the destructive effect of winds and the uses of wind-breaks, read before the recent meeting of the American Forestry Association.

SEEDS—WEEDS.

Germinating seeds in sawdust, G. E. STONE (*Bot. Gaz., 19 (1894), No. 8, pp. 333, 334*).—The author recommends the use of sawdust for germinating seeds. Care must be taken not to use the sawdust of oak, chestnut, or other tannin-bearing wood as it will result in tannin poisoning of the roots, giving them an abnormal growth. Rather coarse sawdust is preferred to the finer. Seeds may be sown in well-drained pots and watered at least once a day. The roots of sawdust cultures present characteristics in their growth which are closely allied to roots grown in moist air.

Germination experiments with beet seed, A. VIVIEN (*Ztschr. Ver. Rübenz. Ind., 1894, Aug., pp. 653–656*).

Reports of Oerebro Seed Control Station for 1891 and for 1892, J. WIDEN (*Oerebro, Sweden: 1892, pp. 9; 1893, pp. 10*).

A contribution to the physiology of Cuscuta, D. T. McDOUGAL (*Bot. Gaz., 19 (1894), No. 8, pp. 331, 332*).—Notes are given of some observations on the haustoria and the twining habits of this plant.

Prickly lettuce and other weeds in Iowa, L. H. PAMMEL (*Garden and Forest, 7 (1894), p. 358*).—A report is given on the spread of prickly lettuce (*Lactuca scariola*), oxeye daisy (*Chrysanthemum leucanthemum*), squirrel-tail grass (*Hordeum jubatum*), spiny nightshade (*Solanum rostratum*), and Mexican poppy (*Argemone mexicana*).

DISEASES OF PLANTS.

Second report on rusts of grain, A. S. HITCHCOCK and M. A. CARLETON (*Kansas Sta. Bul. 46, pp. 9*).

Synopsis.—Reports are given on the additional observations of the wintering of *Puccinia rubigo-vera*, observations on *P. graminis*, inoculation experiments, and spraying experiments.

This report is a continuation of the previous report given in Bulletin 38 of the station (E. S. R., 5, p. 497), in which was given the life history of grain rusts and records of experiments on the prevention of rusts by means of spraying. In the previous report the opinion was expressed that the spores of *Puccinia rubigo-vera* were not formed during the winter, but probably retained their vitality from the time of formation in the previous autumn, and it was left unsettled as to whether the mycelium lived over winter or not.

In order to test this point a few plants supposed to be infected were transferred to the greenhouse on March 9. On March 16 a number of bright red spots appeared, showing the uredospores of the rust. On March 22 observations in the field showed the rust was spreading upon the leaves quite rapidly.

Culture experiments were made with the uredospores taken from plants, which showed that the spores retained their vitality throughout the winter. From these experiments and observations the authors conclude that *P. rubigo-vera* passes the winter in the tissues of the wheat in a mycelial condition, and that the uredospores retain their vitality throughout the winter.

The observations upon *P. graminis* showed that while the rust was quite abundant in 1893 it was impossible to find any evidence of its presence during the winter, and it is probable that it does not pass the winter in the vicinity of the station either in the mycelial or uredo stage.

The authors made numerous inoculation experiments to ascertain the relation of rusts of wheat to those of other cereals and grasses. Wheat, oats, rye, barley, and corn were inoculated with the spores of *P. graminis* from wheat and oats, *P. sorghi* from corn, and *P. rubigo-vera* from wheat and blue grass; but in all cases no infection followed

the inoculation except where the rust was taken from the same kind of host upon which it was inoculated. Plants of oats, wheat, rye, and orchard grass were inoculated in October with uredospores of *P. graminis* from oats. Of these only the oats were infected. At the same time another series of plants was inoculated with the uredospores of *P. rubigo-vera* from wheat, and only the wheat plants were infected. In all cases where infection resulted the period of incubation was about 13 days.

These experiments seem to show that there is little danger of infection from one kind of grain to another.

Spraying experiments were made to determine what chemicals would prevent rust when applied in solutions of such strength as to avoid injury to the plant when sprayed. The compounds of the following were used in solutions of various strengths: Potassium bichromate, mercuric chlorid, copper sulphate, copper acetate, copper nitrate, lead acetate, copper chlorid, ferric chlorid, zinc chlorid, and ferrous sulphate. To these fungicides were afterwards added common salt and boric acid.

Tabulated information is given as to the varieties of wheat experimented upon, strength of solution, and effect of the fungicide upon the plant.

The spraying was not begun until 3 days after the rust began to appear, and it ran its course so rapidly that time was given for but one spraying. At the same time *P. graminis* began to appear upon the oat crop, and the same fungicides, with the exception of copper chlorid, copper acetate, and zinc chlorid, were tested upon the oats.

The two requisites found necessary for the successful spraying of rusts seem to be (1) to obtain a solution of sufficient strength to effectually combat the rust without injury to the plant, and (2) to find some method of covering the plants more completely with the spray. The former requisite the authors consider as practically within their reach.

On June 28, specimens of the plants were taken from the treated plats and compared as to the amount of rust with specimens from untreated portions. Taking the average amount of rust on the untreated portions as 100 per cent, the amounts on the plats treated with the different fungicides were approximately as follows: Salt, 100 per cent; boric acid, 85; ferrous sulphate, 85; lead acetate, 85; copper sulphate, 50; copper nitrate, 25; mercuric chlorid, 25; potassium bichromate, 10; and ferric chlorid, 10.

The authors' conclusions are as follows:

"(1) In the vicinity of Manhattan, the common wheat rust, *Puccinia rubigo-vera*, passes the winter in the tissues of the wheat plant in the mycelial condition. During the warm weather of spring a crop of spores is produced which under favorable conditions may rapidly spread the disease. The infection of the winter wheat in the fall is materially aided by volunteer wheat, which carries the rust through the few months following harvest. The red rust spores are capable of maintaining their power of germination through the winter and thus infecting the crop the following spring.

"(2) There is no evidence to show that the second kind of wheat rust, *Puccinia graminis*, survives the winter here, either in the mycelial condition or in the uredo stage, though it may do so further south.

"(3) A series of inoculation experiments shows that both wheat and oats are easily infected by rust from the same kind of grain, but not by the same kind of rust from other grains; *e. g.*, wheat is infected by rust from wheat, but not by rust from oats, corn, or blue grass. Hence there is little danger of infection from one kind of grain to another.

"(4) The spraying experiments show that certain fungicides, as potassium bichromate and ferric chlorid, are effective in preventing rust, but that with our present knowledge concerning methods of spraying it seems impossible to sufficiently cover the foliage. For this reason, although the rust can be largely decreased, we can not attain prevention, as is done in such diseases as the grape mildew. Furthermore, it is extremely doubtful if spraying of wheat or oats would pay, even if effective.

"A more promising plan is the breeding of varieties of grain which shall be rust resisting—the so-called 'rust-proof' varieties."

A new disease of wheat, A. PRUNET (*Compt. Rend., 119 (1894), No. 1, pp. 108–110*).—In certain districts in southwestern France there has appeared a formidable disease of wheat causing very serious loss, the complete measure of which can not be estimated even at harvest time. The disease is characterized by a checked growth, and after some time the upper leaves turn yellow and dry up. The growth becomes irregular and one may find in the same field diseased culms 10 to 12 cm. high among normal ones. The yellowish or dried culms are more or less stunted, forming patches of greater or less extent in the fields. The disease is caused by a parasitic fungus of the family *Chytridiaceæ*. The zoöspores, as in all members of this group, are motile and penetrate the tissues of the wheat, piercing the walls of the surrounding cells. Upon germination they produce a branched intercellular mycelium composed of very delicate filaments of pure protoplasm, spreading widely, and difficult to distinguish. Here and there the filament swells, forming a terminal or intercalary sphere furnished with a nucleus and representing a zoösporangium. After having been formed the zoösporangia are surrounded by a thin membrane, growing within which are the spores, ordinarily ovoid or pyriform according to the walls of the cells containing them. The mycelium usually disappears before the zoöspores attain their full growth. The mature sporangia are 15 to 50 μ in diameter. The zoöspores which are at first angular, become spherical, furnished with a refractive nucleus and a cilium. The average diameter of the spores is about 3 μ. After the zoöspore has become attached to a cell wall it develops a filament which penetrates the neighboring cells, spreading to form new zoösporangia. The generations of the fungus increase rapidly in all parts of the plant, root, stem, leaves, and flowers. In the ovules its presence causes a more or less complete abortion of the ovule. The number of the zoösporangia contained in a cell is variable, although very numerous, 19 having been counted in a single cell. They are found in all tissues, even in the thick-walled sclerenchyma, or on the epidermis, where the zoöspores spread the disease.

After the nourishment in the plant is exhausted the zoösporangia become cysted, taking on a very thick dark brown and slightly spiny wall. The cysts are less spherical and ordinarily are smaller than the sporangia. In this state the parasite can endure extremes of drought and cold and thus perpetuates itself from year to year.

From the nature of the mycelium, method of formation of zoösporangia, form and dehiscence of zoösporangia, coexistence of zoösporangia and cysts the author determined the fungus as an undescribed genus of *Chytridiaceæ*, to which he gives the name *Pyroctonum sphæricum.*

The author states that this is the first time a member of this group has been reported as attacking field crops so as to cause serious loss. Without doubt the abundant rains of the spring aided very greatly in its growth, but under ordinary weather conditions a fungus capable of such extensive and rapid spreading will prove destructive.

The burning of the stubble and occasional rotation should be employed in infested regions. Straw and litter from the wheat should not be used as manure, as the cysts will be carried over uninjured. Seed wheat from infested regions should not be used, as it, too, may carry the cysts.

Potato scab, L. R. TAFT and R. J. CORYELL (*Michigan Sta. Bul. 108, pp. 38–45, figs. 3*).

Synopsis.—Report of successful tests of corrosive sublimate and Bordeaux mixture for the prevention of potato scab. Corrosive sublimate solution, 1 part to 1,000 or 1 to 2,000, gave most decisive results.

The authors carried on investigations for the purpose of finding the best strength and the proper time for soaking the seed to prevent potato scab. In treating with corrosive sublimate three strengths were used—1 part of corrosive sublimate to 750 parts of water, 1 part to 1,000, and 1 part to 2,000. The soil where the potatoes were planted was of a very uniform clay loam which had been cropped with garden vegetables for about 20 years and received an annual dressing of compost for most of the time. No potatoes had been grown upon it for 6 years.

No definite information was gained from the treatment where the stronger solution was used, except that it was fairly successful in preventing the scab and that the seed treated a long time was slower in sprouting. With the weaker solutions—1 part to 1,000 and 1 part to 2,000—practically the same results were obtained. The scab decreased as the length of treatment increased, as did also, within certain limits, the yield.

If the strength of solution be disregarded the results of the tests are expressed in the following table:

Prevention of scab by treating seed with corrosive sublimate.

No. of plats.	Length of treatment.	Yield.	Per cent scabby.
8	Untreated	119.3	60.1
6	¼ and ½ hour	134.3	15.2
6	¾ and 1 hour	123.1	18.2
6	1¼ and 1½ hours	129.0	6.8
6	1¾ and 2 hours	125.6	9.6
6	2¼ and 2½ hours	116.1	6.1
4	3 hours	108.0	4.3
6	3½ and 4 hours	117.5	4.8

From this table it will be seen that those immersed for an hour or less have a comparatively large percentage of scab. The longer immersions show that the scab decreases very slowly, and that for practical purposes 1½ hours is sufficient. It will also be noticed that the yield increases to a certain point, after which there is a gradual decrease. Checking the scab seems to cause increased growth, but where the seed is immersed 2 hours or more the plants are so slow in starting that the increase is overcome.

A duplicate of these experiments was tried on land that grew a crop of potatoes in 1892. There was much more scab in the duplicate experiments, showing that the germs from the previous crop remained in the soil and prevented the treatment from being a complete success, although the amount of scab was reduced to about half.

The effect on the solution of treating the seed was tested, showing that the amount of corrosive sublimate diminishes as the potatoes are soaked in the solution, and taking this as a basis it is advised after soaking about 12 bu. of potatoes in 15 gal. of solution to add ¾ of an ounce of the corrosive sublimate; otherwise the solution will become too weak.

The Bordeaux mixture tested was made by taking 4 lbs. of sulphate of copper, 3 lbs. of lime, and 32 gal. of water. It made nearly as good a showing as the corrosive sublimate, so far as the per cent of scabby tubers is concerned, but in the size of the scab spots there was no difference between those on the treated plats and those on the untreated. Trials under more diverse conditions are necessary to establish the value of this treatment.

Practical suggestions are given for treating the potatoes for scab.

Leaf blight of potato, L. R. TAFT and R. J. CORYELL (*Michigan Sta. Bul. 108, p. 47*).—A brief account is given of a bacterial disease which has been injurious at the station for several years. It appears during hot dry weather and is especially severe on the early and medium varieties at the time they are half grown. The vines killed by the leaf blight are readily distinguished from those killed by the drought. In the former case the leaf turns black at or near the tip. This blackened area increases until about one half or three fourths of the leaf surface

is affected. At this stage if the weather continues unfavorable the drought aids in killing the weakened vines. Vines killed by heat and dry weather lack the discolored leaflets, and the leaf stems and small branches hang pendant on the upright stalks.

A bacterial disease of cabbage, H. GARMAN (*Kentucky Sta. Rpt. 1890, pp. 43–46*).—In 1889 the cabbage in the vicinity of the station was affected with a rot which seemed to be of a bacterial nature. In some gardens two thirds of the heads were affected, more than half of which were finally rendered worthless. The disease often appeared on the outer leaves first, rendering the whole surface of the head black, but more often there was an internal decay which resulted in the affected heads breaking off at the stalks and falling to the ground. The conditions most favorable to the rapid extension of the disease are moisture and heat, and it was especially destructive during some very warm weather in July. The invaded leaves become brown and watery at first, and later, when the disease has reached an advanced stage, become black. When thoroughly infested the heads give off a peculiarly obnoxious odor. None of the higher parasitic fungi were found in the affected plants which could in any way have caused the disease, and at the time of rotting the only other organisms associated with it were 2 species of scavenger beetles.

Numerous successful inoculations were made. The author conducted a series of cultures in order to isolate the bacteria. He found 2 species in abundance. The most abundant species constituted about two thirds or three fifths of all the individual specimens. They were always motile, and in doubles, never in chains. In size and behavior the species resembled *Bacterium termo*. With it occurred small numbers of a larger bacillus, often in short chains, but generally in doubles, which measured about 0.0042 in. in length. In shape it was not unlike the smaller bacteria, with short, thick, rounded extremities, and staining solidly. These 2 species were always abundant in the agar cultures, the bacillus producing a white growth and the bacterium a more rapid yellow growth.

A few tests which were made in the fall of the year with cultures of the 2 species of bacteria were without decisive results. Since the summer of 1889 opportunities have not been offered for the further study of this disease.

The brunissure of the grape, F. DEBRAY (*Compt. Rend., 119* (*1894*), *No. 1, pp. 110, 111*).—During the month of May this disease appeared in many of the vineyards about Algiers. The temperature had been unusually cold, accompanied by fog, and there had been frequent heavy rains. The vines developed very slowly and their leaves were much smaller than usual. In some regions the young shoots were greatly elongated, and while the shoots themselves were not attacked their lower leaves were diseased, the upper ones remaining sound. Most plants lost their shoots by their becoming completely dried up.

The leaves on most vines were brown, the disease being first manifest by the appearance of irregular brownish spots. With some varieties, as the Carignan and the Bouchet, the spots were rarely observed, but the leaves took on a red color. Some leaves presented on their lower surfaces a sulphur color due to the presence of the parasite among the pubescence.

The attack on the vine is described, and from the diagnosis given it is considered to be due to the disease described by Viala and Sauvageau as caused by *Plasmodiphora* sp. The fungus was observed in the superficial cells of the stem, tendrils, petioles, and leaf blades, as well as on the surface of these organs and among the hairs. When the fungus appears intermingled with the pubescence it is seen as globular masses, more or less flattened and irregular, lobed or reticulated, generally containing small vacuoles.

The spores, the formation of which the author describes, are oval, smooth, and generally 10 to 12 μ in diameter, although rarely only 8 or 9 μ.

Applications of sulphur, Bordeaux mixture, and hydraulic lime in a very fine powder have been made to prevent this disease without effect.

The scald of grape leaves caused by Exobasidium vitis, PRILLIEUX and DELACROIX (*Compt. Rend., 119 (1894), No. 1, pp. 106–108*).—Specimens have been received by the authors from many widely scattered vineyards showing that the grapevines were suffering from "rougeot" or scald. The disease is characterized as follows: The color of the leaves is modified; they take on a livid shade which, by drying up, becomes fawn-colored along the edge. At the same time rose-purple-colored areas appear which at first slightly modify the green color of the leaf, but become more intense until the central portion of the still living leaf is a rose color. In the dead portions there appear efflorescent spots resembling a fine powder of plaster or lime, forming here and there small thick masses of a dead white color. These are the fruiting filaments of the parasite, furnished with myriads of spores.

Specimens have been received showing the constant presence of the same parasite, which differs in no respect from that described by Viala and Boyer as *Aureobasidium vitis*.

The slightly yellow mycelium is septate, loose, or slightly aggregated; its ultimate branches which enter between the cells are hyaline and very slender. In spots it bursts the epidermis and sends out tufts of elongated sterile filaments upon the surface of the leaf. The fertile filaments frequently have massed at their extremities true basidia, which carry a number of true spores at the extremity of short sterigmata. Usually the basidia terminate the mycelium, but sometimes they appear laterally borne on very short branches. Some of the filaments are very delicate, occasionally transverse celled, terminating in basidia, while others much more robust form short thick-walled bodies, resembling buds, which ordinarily are sterile but in special cases put out short lateral branches bearing basidia and spores. The basidia are

always hyaline, ordinarily 8 to 10 μ in length. The number of spores varies from 2 to 9 to each basidium, being most numerous on the terminal ones.

The spores are hyaline, straight or slightly arched, ovoid or cylindrical, attenuate at the ends. Their form and size vary greatly, being from 4 to 6.5 μ to 12 to 16 μ in length. By the formation of vacuoles the plasma is separated into several masses, but true walls are not formed to make the spore multicellular. The extremities of the spores show buds which sometimes become proliferous, giving it the appearance of a short chain.

The authors think from the above description there are no differences which warrant the erection of the genus *Aureobasidium* by Viala and Boyer, but that it is a true *Exobasidium*.

On the other hand, Viala and Boyer (*Compt. Rend.*, *119* (*1894*), *No. 3*, *pp. 248*, *249*) agree with the authors in their characterization of the fungus, but maintain that the fungus belongs to the *Hypochnaceæ* and should bear the name *Aureobasidium vitis*, as given it by them in 1891. They further report having found the fungus on the leaves and already announced it (*Rev. Vit.*, *1891*, *June 30*, *p. 684*).

It produces the scald on the leaves in May and June, and attacks the fruit in autumn.

The exact amount of destruction caused by this comparatively new parasite is not yet known, although in some regions it is reported as very destructive. Treatment with copper compounds has not arrested the disease, but this may have been due to too late applications.

A. Renault (*Compt. Rend.*, *119* (*1894*), *No.3*, *pp. 247*, *248*) states that one of the principal sources of contamination lies in the prevailing custom of tying the shoots together in order to prevent their being broken by the winds, and thus presenting at the point of tying a favorable location for the development of the fungus. He shows that in one case where part of the shoots of a vine were tied together and the remaining part left free, the shoots of the tied portion were affected by the disease while the others were perfectly free from it. He recommends as a preventive measure the wiring of the shoots to some strong support.

Bacteriosis of grapes, L. MACCHIATI (*Rev. Internat. Vit. et Œnol.*, *1* (*1894*), *No. 3*, *pp. 98–109; 4*, *pp. 129–136*, *pls. 2*).—In 1891, in northern Italy, shortly after the flowering period, the grapes were noticed to be drying up with great rapidity, without showing any of the symptoms of ordinary diseases. When examined they showed no trace of fungus or animal parasite, nor did there seem to be any lack of nutrition in the plant.

By continued observation the author finally discovered that the disease was due to a bacillus. Since the first discovery of the disease it has been reported from many widely scattered districts. In some cases the crop was a total failure; in others, the loss was from 60 to 80 per cent.

Sometimes it appears in June, to reappear again later in the same year, or it may appear only once, in August or September. In 1892 and 1893 the disease had spread still farther throughout Italy.

At the appearance of the disease the tip of the main stalk of the clusters and its branches took on a brownish color. It spread more or less rapidly, destroying flowers and the forming grapes, until the whole cluster may become dried up, or sometimes only half of a single grape may be affected, the rest remaining sound. Sometimes a few branches of the cluster may be affected, the others showing no traces of the disease. If the disease appears later in the season its course is less rapidly run, but it is none the less disastrous. The dried grapes fall to the ground or, if they remain on the vine, become centers for spreading the disease.

Various authors have attempted to identify this disease as a phase of a well-known bacillus, but the present author considers it totally different from any hitherto described as affecting the grape.

Observations and experimental inoculations with pure cultures of the bacteria seem to show that varieties derived from *Vitis vinifera*, and especially the white-fruited ones, are the most subject to this disease. The bacteria develop only within certain limits of temperature. The spores begin to grow when the night temperature does not fall below 10 to 12° C., and ordinarily a temperature of 32 to 35° checks the development. The greatest and most rapid growth is made between 25 to 30° C., provided there be sufficient moisture in the air.

Vines which are exposed on the north and west are most liable to attacks of the disease, as they are less subject to the drought. The nature of the soil has no immediate effect on the disease, but it is indirectly affected by the degree of hygroscopicity of the soil and its ability to absorb and retain heat.

The author made an elaborate botanical study of the bacteria causing this disease, and his methods of manipulation are given in detail. The bacteria are easily found, as they penetrate all the tissues of the fruit, the inflorescence, and parts of the flowers, especially in the mesophyll tissue, and are even to be found in spiral vessels, cambium layer, and fibrovascular vessels. The bacilli of the disease when in their natural condition, that is, when in the fruit, are thin, straight, or slightly curved, with rounded extremities, 3 to 4 μ long by 1 to $1\frac{1}{4}$ μ in diameter. They move rapidly and are easily stained with aniline stains. In the fruit they are never found in chains but always isolated, and in some cases spore bearing.

Numerous successful cultures and inoculations were made, the methods and results of which are given in detail. The article is illustrated by 2 handsomely colored plates, showing some of the various stages of the disease and the double-stained bacillus in position and cultures.

Recent contributions to mycology, L. H. PAMMEL (*Agl. Sci., 8 (1894), No. 4, pp. 183–191*).

Peach yellows and peach rosette, E. F. SMITH (*U. S. Dept. Agr., Farmers' Bul. 17, pp. 20, figs. 7*).—A popular bulletin prepared in the Division of Vegetable Pathology, giving information as to the distribution, description, means of spreading, and preventive measures adopted against peach yellows and peach rosette. In an appendix to the bulletin the Connecticut and Pennsylvania laws relating to peach yellows are given. A more technical bulletin on these diseases was issued by the division as Bulletin 1 (E. S. R., 3, p. 485).

The broom rape of hemp and tobacco, H. GARMAN (*Kentucky Sta. Rpt. 1890, pp. 57–73, figs. 8*).—Reprint of Bulletin 24 of the station (E. S. R., 2, p. 22).

Æcidium asperfolii, H. WIGLEY (*Gard. Chron., 16 (1894), ser. 3, p. 222*).—Report of finding this, the æcidium stage of *Puccinia rubigo-vera*, on *Lycopsis arvensis*.

A new Australian fungus, N. A. COBB (*Agl. Gaz. N. S. W., 1894, June, p. 390, fig. 1*).—A *Peziza* found on a species of *Lyonsia*, probably *L. reticulata*, is described and the name *P. Lyonsiæ* is proposed.

Notes on the Exoasceæ of the United States, G. F. ATKINSON (*Torrey Bul., 21 (1894), No. 8, pp. 372–380*).—Critical notes are given on many of the prominent species, together with descriptions of the following new species: *Exoascus confusus, E. longipes, E. decipiens, E. decipiens superficialis, E. mirabilis, E. mirabilis tortilis, E. rhizipes, E. varius, E. cecidomophilus*, and *E. australis*.

A new gummosis of Carpinus betulacea and a disease of chestnut, F. LUDWIG (*Centbl. Bakt. u. Par., 16 (1894), No. 2, pp. 58–61*).

Influence of humidity of calcareous soils on the development of chlorosis, HOUDAILLE and MAZADE (*Compt. Rend., 119 (1894), No. 4, pp. 304–307*).—Chlorosis seems dependent upon amount of lime in soil, fineness of soil, and its humidity. In general the amount of chlorosis seems to be inversely proportional to the degree of saturation of the soil.

A new sclerotium-forming Penicillium, C. WEHMER (*Hedwigia, 33 (1894), No. 4, pp. 212–214*).—*Penicillium italicum* is described as a new species of sclerotium-forming mold.

Puccinia ribis, C. B. PLOWRIGHT (*Gard. Chron., 16 (1894), ser. 3, p. 135*).—Account of the appearance of this fungus in Scotland. The author states that this is not the puccinia stage of *Æcidium grossulariæ*, as is frequently claimed, and that it is never found on the gooseberry.

Puccinia winteriana, P. SYDOW (*Hedwigia, 33 (1894), No. 4, p. 205*).—Brief notes on the botanical relationship of this species.

New Californian Uredineæ, II, P. DIETEL (*Erythea, 2 (1894), No. 8, pp. 127–129*).

Sclerotinia in Alnus fruits, R. MAUL (*Hedwigia, 33 (1894), No. 4, pp. 215–228, pls. 2*).—Description and life history of *S. alni*.

New species of Uredineæ and Ustilagineæ, with notes on other species, II, P. DIETEL (*Bot. Gaz., 19 (1894), No. 8, pp. 303–306, pl. 1*).

Notes on Uromyces cladii, B. D. HALSTED (*Torrey Bul., 21 (1894), pp. 311–313*).—Account of a rather unusual distribution on its hosts, *Arisæma triphyllum* and *Peltandra virginica*.

Begonia diseases, B. D. HALSTED (*Amer. Florist, 10 (1894), p. 117, figs. 2*).—The author figures and describes a nematode and a fungus disease of begonia leaves.

Cane disease (*Roy. Bot. Gard. Trinidad, Misc. Bul. 23, pp. 287–289*).—Report of correspondence showing the presence of fungus diseases of cane as early as 1878.

Diseases of the grape, G. MASSEE (*Gard. Chron., 16 (1894), ser. 3, p. 75, figs. 2*).—Illustrated notes on downy mildew (*Plasmopara viticola*) and a "spot" disease due to *Glœosporium* sp.

The black rot of grape, B. BATTANCHON (*Prog. Agr. et Vit., 11 (1894), pp. 86, 87*).—Report of appearance of black rot in Saone-et-Loire.

Conditions of the development of rougeot on the leaves of grapes, A. RENAULT (*Compt. Rend., 119 (1894), No. 3, pp. 247, 248*).

Vine leaf clubbing, B. PIFFARD (*Gard. Chron., 16 (1894), ser. 3, p. 136*).—Trimming the vines in autumn and washing with a solution of iron sulphate, 1 oz. in 1 pint of water, prevents attacks of browning, or "brunure," due to *Myxomycetes* sp.

Carnation rust experiments, W. STUART (*Amer. Florist, 9 (1894), pp. 1231, 1232*).—A report on fungicides tested, in which it appears that Bordeaux mixture of standard and half strength solutions gave the best results.

Iris and lily disease, A. WALLACE (*Gard. Chron., 16 (1894), ser. 3, pp. 221, 222; also Garden, 44 (1894), pp. 172, 173*).—A popular description of a diseased condition of these plants, due, the author thinks, to cold weather and hard rains preparing the way for fungus attacks.

Lettuce mildew, L. R. TAFT (*Amer. Gard., 15 (1894), No. 21, p. 375*).—A popular description of *Botrytis vulgaris*, with suggested means for the prevention of its attacks.

Diseases of mushrooms, J. COSTANTIN and L. MATRUCHOT (*Rev. gén. Bot., 6 (1894), No. 67, pp. 289–300, pl. 1*).—Descriptions are given of *Myceliophthora lutea* and *Monilia fimicola*, parasitic fungi of mushrooms.

An onion disease, G. MASSEE (*Gard. Chron., 16 (1894), ser. 3, p. 160, fig. 1*).—Illustrated description of *Sclerotinia bulborum*. It has been reported on hyacinths, lilies, and onions. Spraying with a solution of potassium permanganate or Bordeaux mixture during the botrytis stage is recommended. Its first appearance is in the form of small yellow spots on the leaves in spring, the blotches increase in size, become brownish, and covered by a very delicate velvety olive-brown mold. It is at this stage when the spraying should be given.

Blight of garden pinks, B. D. HALSTED (*Amer. Florist, 10 (1894), pp. 5, 6*).—Popular description of *Septoria dianthi* and its occurrence on carnations, warning florists to prevent its spreading to the more valuable plants.

The potato disease (*Gard. Chron., 16 (1894), ser. 3, pp. 132, 133*).—A popular summary of the report of the board of agriculture of Great Britain for 1892 and 1893, with suggestions for its treatment (E. S. R., 5, p. 425).

Quince rot, G. H. POWELL (*Garden and Forest, 7 (1894), p. 337*).—A popular description of the disease and the relation existing between it and cedar apples is explained. Destroying the cedar trees and spraying quince trees with Bordeaux mixture are recommended.

A mosaique disease of tobacco, D. IWANOWSKY (*Bul. Acad. Impér. Sci. St. Petersburg, 35 (1892), No. 1, pp. 67–70*).

Notes on diseases of plants, N. A. COBB (*Agl. Gaz. N. S. W., 1894, June, pp. 379–390, figs. 15*).—Notes are given on bean anthracnose, bean rust, peach freckle, black rot of tomatoes, mango blight, and *Helminthosporium ravenelii* on *Sporobolus indicus*.

Concerning the direct influence of Bordeaux mixture on potato plants, FRANK and KRÜGER (*Mitt. deut. landw. Ges., 1894, 2, pp. 46; abs. in Bot. Ztg., 52 (1894), No. 16, II, pp. 247, 248*).

A new method of treating the root rot of the vine produced by Dematophora necatrix, FOËX (*Abs. in Agricol. e Ind. Agr., 17 (1894), No. 13 and 14, pp. 209, 210*).—Bisulphid of carbon was used.

ENTOMOLOGY.

The chinch bug in southern Illinois in 1894, S. A. FORBES (*Illinois Sta. Bul. 33, pp. 397–399*).—This is an emergency bulletin, briefly recounting the damage being done to crops in 24 of the southern counties, and giving advice as to remedies. It is recommended to surround fields with deep furrows, in which kerosene and water are placed, and also to plant strips of favorite food plants where the bugs may accumulate and be destroyed before laying their eggs for the second generation; but the most reliance is placed in contagious diseases. Directions are given for sending chinch bugs to the station to be inocu-

lated with fungus diseases, and sent back for distribution in the fields. A combined and concerted campaign is advocated and emphasized.

Report of the entomologist, H. A. MORGAN (*Louisiana Stas. Bul. 28, 2d ser., pp. 982–1005, figs. 8.*)—This deals with the treatment for biting and sucking insects, the arsenites being advised for the former and kerosene and rosin emulsions for the latter, receipts for compounding the insecticides being included. Fish-oil emulsion is recommended for flies and gnats.

Notes are given on the following species, and in most cases descriptions, life histories, and treatment. The sugar cane borer (*Chilo saccharalis*), screw worm fly (*Lucilia macellaria*), Angoumois moth (*Gelechia cerealella*), corn weevil (*Calandra oryzae*), purple scale (*Mytilaspis citricola*), Glover scale (*M. gloverii*), red scale (*Aspidiotus ficus*), walnut scale (*A. juglans-regiæ*), round white scale (*A. nerii*), greedy scale (*A. rapax*), chaff scale (*Parlatoria pergandii*), white fly (*Aleyrodes citri*), Camelia japonica scale (*Fiorinia fioriniæ* var. *camelliæ*), rose scale (*Dissis rosæ*), sweet potato borer (*Cylas formicarius*), chinch bug (*Blissus leucopterus*), peach borer (*Sannina exitiosa*), fig borer, and cattle tick (*Boophilus bovis*).

Observations on farm pests, H. GARMAN (*Kentucky Sta. Rpt. 1890, pp. 9–40, figs. 7*).—Original and compiled notes on various insects, descriptions, life histories, and treatment being given. The corn-root worm of Kentucky (*Diabrotica 12-punctata*), grain louse (*Siphonophora avenæ*), tobacco worm (*Phlegethontius carolina*), strawberry scale insect (*Aleurodes vaporarium?*), and myriapods (*Cambala annulata* and *Parajulus impressum*) are discussed. Descriptions are given of 3 parasitic Hymenoptera, *Apanteles congregatus*, *Ætroxys tabacum*, and *Mesochorus* sp., infecting the tobacco worm, and a wheat spring tail (*Smynthurus* sp.) which devours parasitic fungi on young wheat in the spring is also described and figured.

Rotation of crops is advised in the case of the corn-root worm, and against the grain louse a strong extract of tobacco stems or weak kerosene emulsion is suggested, and also the planting of trap strips of oats to attract the lice, which can be plowed under when infested. Hand picking, and planting Jamestown weed, the flowers of which are to be poisoned with cobalt, arsenic, or strychnine, are recommended against the tobacco worm. An infusion of tobacco or a solution of naphthaline was found to kill myriapods quickly.

Bordeaux mixture as an insecticide, H. GARMAN (*Kentucky Sta. Rpt. 1890, pp. 40–43*).—On account of the effect produced in deterring the attacks of cucumber flea beetles and margined blister beetles on potatoes by spraying with Bordeaux mixture, experiments were made to ascertain its value as an insecticide. Tobacco worms, grasshoppers, and Colorado potato beetles were confined in breeding cages and supplied with sprayed food plants. All of the tobacco worms and grasshoppers succumbed, while individuals kept as checks remained vigorous. The potato beetles, however, were but slightly affected,

only 2 out of 13 dying. It is thought the results show that Bordeaux mixture can be used advantageously as an insecticide upon such plants as will not be injured for food by having the lime on their foliage, and on others it may be used very early in the season, so that following rains will wash off the lime before the crop is used.

Insecticides and spraying, J. M. ALDRICH (*Idaho Sta. Bul. 7, pp. 18, figs. 14*).—Popular notes on insecticides, with formulas and directions for their application, and illustrated descriptions of various kinds of apparatus for spraying. Especial mention is made of spraying for the codling moth and San José scale, Paris green being recommended for the former, and a sulphur, lime, and salt solution in the winter for the latter.

Our common insects, G. MCCARTHY (*North Carolina Sta. Bul. 100, pp. 181–216, figs. 65*).—A compiled general and popular illustrated bulletin on some of the commoner hexapods, arachnids, and myriapods, with remarks on the classification and life histories of insects. Some of the more notorious injurious and beneficial insects are described, and brief directions are given for combating noxious insects and for forming entomological collections. A short list of books on entomology is appended.

A family of water kings, C. M. WEED (*Pop. Sci. Monthly, 1894, Aug., pp. 443–446, figs. 5*).—An account of habits of giant water bugs, especially *Belostoma americana*, *B. griseus*, *Zaitha fluminea*, and *Notonecta undulata*.

A classification of Lepidopterous larvæ, H. G. DYAR (*Ann. N. Y. Acad. Sci., 8 (1894) No. 4, pp. 194–232, figs. 5*).—A new and apparently natural classification by means of the setiferous tubercles on the abdominal segments. A key, synopsis, and many descriptions are given.

The physiological mechanism of the generative apparatus of grasshoppers, J. K. D'HERCULAIS (*Compt. Rend., 119 (1894), No. 3, pp. 244–247*).—Notes on the mechanism of oviposition in several species.

The poison gland of chilopod myriapods, O. DUBOSCQ (*Compt. Rend., 119 (1894), No. 5, pp. 352–354*).—Anatomical descriptions of the venom apparatus, especially that of the centipede *Scolopendra cingulata*.

Cecidomyia destructor, A. GIRARD (*Bul. Soc. Ent. France, 1894, No. 10, pp. 139, 140*).—Remarks on the relationships of the Hessian fly.

The metamorphoses of Cecidomyia destructor, A. LABOULBÈNE (*Compt. Rend., 119 (1894), No. 4, pp. 297–300*).—A description, chiefly compiled from American sources, of the life history of the Hessian fly, with some original notes.

The codling moth, A. MOLINEUX (*Garden and Field, 20 (1894), No. 2, pp. 69, 70*).—A paper on the codling moth with reference to its presence and ravages in Australia, the description, life history, and treatment being given. Energetic and combined efforts for its destruction are urged.

An invasion of Heliophobus popularis in northern France, P. MARCHAL (*Bul. Soc. Ent. France, 1894, No. 11, pp. 156–159*).—Report of a trip to a region being devastated by the caterpillars of this species, which destroy all foliage and plants except such as have a very acrid juice. Digging trenches around fields to be protected is advised, and burning the trapped larvæ or killing them with quicklime.

The San José scale, J. B. SMITH (*Garden and Forest, 7 (1894), p. 374, fig. 1*).—Gives an account of the occurrence of *Aspidiotus perniciosus* on pears bought in the markets of Philadelphia, New York, and Brooklyn.

"Bete rouge" (*Roy. Bot. Gard. Trinidad, Misc. Bul. 23, pp. 276, 277*).—Brief notes on *Trombidium* sp. The Trinidad species is shown to be only two thirds the size of the Jamaica one.

Insecticides for use against the larvæ of Eudemis and Conchylis (*Staz. Sper. Agr. Ital., 26 (1894), pp. 501–503*).

Fertilizers as insecticides, L. DUMAS (*Jour. Agr. Prat., 58 (1894), No. 33, pp. 242–244*).—The use of petroleum for preserving manure and disinfecting sewers is recommended, and it is claimed that manure and sewage so treated is valuable for combating insects and fungus diseases.

Insect pests, treatment (*Garden and Field, 20 (1894), No. 2, p. 54*).—Directions for combating the codling moth, peach aphis, and a few other insects, with receipts for insecticides.

Insect damage to red beeches, F. THOMAS (*Forstl. naturw. Ztschr., 3 (1894), No. 8, pp. 321–327*).—A faulty unfolding of the leaves was produced by insect attacks upon the buds.

Fungus diseases against Silpha opaca, J. DANYSZ (*Bul. Soc. Ent. France, 1894, No. 13, pp. 181–184*).—On account of the destructiveness of *Silpha opaca* to beet foliage, experiments were made with the fungi *Sporotrichum globuliferum* and *Isaria destructor*. The first was found to kill the larvæ in from 2 to 9 and the adults in from 7 to 9 days after inoculation. The other acted a little slower, but as effectually. The method of treatment is recommended.

The ichneumon flies of Europe and adjacent countries, G. V. BERTHOUMIEU (*Ann. Soc. Ent. France, 63 (1894), No. 2, pp. 241–274*).—The first part of an elaborate paper, treating of the distribution and habits and giving a synopsis of the tribes.

Parasitic and predaceous insects, C. V. RILEY (*Pop. Sci. Monthly, 45 (1894), No. 5, pp. 678–685*).—A popular account of recent investigations in economic entomology.

FOODS—ANIMAL PRODUCTION.

Concerning the digestibility of the pentosans, J. B. LINDSEY and E. B. HOLLAND (*Agl. Sci., 8 (1894), No. 4, pp. 172–183*).—In connection with digestion experiments with sheep at the Massachusetts State Station, the pentosans in the food and in the feces were determined, and from this the percentage digested was calculated. The feeding stuffs tested were hay, Buffalo gluten feed, linseed meal, corn cobs, dried brewers' grains, and wheat bran. The pentosans were determined from the furfurol as usual. Usually 2 or 3 sheep were used for each digestion experiment. The results are given in detail, together with the percentage of pentosans and of nitrogen-free extract in the feeding stuffs tested, and the average digestion coefficients found for these materials. The data for the pentosans are summarized below, together with those for the nitrogen-free extract for comparison:

Digestibility of pentosans and of nitrogen-free extract by sheep.

	Nitrogen-free extract in foods.	Pentosans in foods.	Pentosans digested. Sheep 1.	Sheep 2.	Sheep 3.	Sheep 4.	Average.	Nitrogen-free extract digested (average).
	Per cent.	*Per cent.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per cent.*
Hay (*a*)	48.51	15.08	....	63.04	64.82	62.48	63.45	63
Hay (*b*)	45.56	16.56	62.85	60.09	62.51	64.28	62.43	58
Buffalo gluten feed	50.20	12.70	....	74.78	....	81.80	78.29	81
New-process linseed meal	41.16	9.92	....	85.02	93.74	....	89.38	86
Old-process linseed meal	39.80	9.02	....	85.01	88.06	78.33	83.80	78
Corn cobs	65.77	23.18	61.14	63.22	....	....	62.18	60
Dried brewers' grain	51.09	18.17	55.35	55.35	....	....	55.35	59
Spring-wheat bran	59.39	21.53	....	61.64	62.33	....	61.98	70
Winter-wheat bran	62.83	18.17	....	....	....	63.92	63.92	70

As a rule the percentages of pentosans digested by different sheep agree quite closely. Comparison with the other ingredients of the different feeding stuffs shows that in 6 out of 9 cases the pentosans were practically as digestible as any other group of ingredients.

"With the more concentrated foods the pentosans are as digestible as either the fat, protein, or extract matter. The results make clear that association has a great deal to do with digestibility. In the hays, corn cobs, and brewers' grain, where the woody substance (lignin) is present to a considerable extent, the digestibility of the pentosans is noticeably less than when the incrusting substance is absent. Whether or not the pentosans are chemically united to the incrusting substance is not known, but it is not at all improbable. It is certainly clear that the incrusting substances perceptibly interfere with the digestibility of the xylan or araban. This has also been proved to be the case with cellulose. . . .

"While from 60 to 90 per cent of the pentosans in the present experiment have been removed from the digestive tract in the process of digestion, it has certainly not been demonstrated that they have been assimilated and are of food value equal to that of starch and similar substances. In case of human beings, Ebstein has already proved to the contrary. We hope to be able to throw additional light upon this point in the near future."

The influence of alum, aluminum hydroxid, and aluminum phosphate on the digestibility of bread, W. D. BIGELOW and C. C. HAMILTON (*Jour. Amer. Chem. Soc., 16 (1894), No. 9, pp. 587–597*).—Bread was made from flour known to be free from alum and aluminum compounds, and the digestibility of the albuminoids determined by digestion with pepsin solution, by Stutzer's and Niebling's methods, and by the same methods modified. These different methods of digestion gave results agreeing quite closely, 93.26, 93.57, 93.21, 93.28, and 93.21 per cent of the total albuminoids in the bread being digested.

Bread was then made to which 0.8 and 4.28 gm. of crystallized alum, 0.54 and 2.5 gm. of aluminum hydroxid, and 0.64 and 3.2 gm. of aluminum phosphate, respectively, were added per loaf of 2 lbs. The digestibility of the albuminoids was determined in these loaves by the same methods as enumerated above. The addition of alum or aluminum hydroxid appears to have diminished the digestibility from 1 to 25 per cent, the larger quantity of aluminum hydroxid having the greater effect. When aluminum phosphate was added the digestibility was decreased about 10 per cent.

"It is evident that the presence of alum interferes materially with the gastric digestion, but the aluminum seems to be precipitated by the alkali of the pancreatic fluid, so that a portion of the digestion which should be effected by the former ferment is effected by the latter. . . .

"The influence of aluminum hydroxid on the digestibility of bread is about the same as that of an equivalent amount of alum when present in about the quantity which is usually found as a result of the use of alum baking powder which contains no phosphate.

"The action of aluminum phosphate is quite different, however, for notwithstanding the supposed insolubility of this compound, 10 to 12 per cent of the albuminoids which are digestible in the presence of alum or aluminum hydroxid appear to be insoluble in the presence of an equivalent amount of the phosphate."

The digestibility and nutritive value of margarin as compared with pure butter, A. JOLLES (*Monat. Chem., 1894, pp. 147–163; abs. in Chem. Centbl., 1894, I, No. 24, p. 1088*).—From long feeding trials with a dog the author concludes that under like conditions pure margarin has the same digestibility and the same nutritive value as pure cows' butter.

Fattening lambs, F. B. MUMFORD (*Michigan Sta. Bul. 107, pp. 28*).—An account is given of an experiment with 125 lambs divided into 10 lots and fed from November 30 to March 29 on the following average rations per lamb daily:

Lot 1, 1.47 lbs. corn, 1 lb. roots, 1.4 lbs. hay.
Lot 2, 1.64 lbs. oats, 1 lb. roots, 1.4 lbs. hay.
Lot 3, 1.47 lbs. wheat bran, 1 lb. roots, 1.45 lbs. hay.
Lot 4, 0.80 lb. corn, 0.80 lb. oats, 1 lb. roots, 1.43 lbs. hay.
Lot 5, 0.83 lb. corn, 0.83 lb. bran, 1 lb. roots, 1.43 lbs. hay.
Lot 6, 0.82 lb. oats, 0.82 lb. bran, 1 lb. roots, 1.44 lbs. hay.
Lot 7, 0.55 lb. corn, 0.55 lb. oats, 0.55 lb. bran, 1 lb. roots, 1.40 lbs. hay.
Lot 8, 0.50 lb. oats, 0.50 lb. bran, 5.6 lb. roots, 1.20 lbs. hay.
Lot 9, 0.50 lb. oats, 0.50 lb. bran, 3.4 lbs. silage, 0.82 lb. hay.
Lot 10, 0.84 lb. corn, 0.84 lb. oats, 0.84 lbs. bran, 1.61 lbs. roots, 0.62 lb. hay.

In the case of lot 10 the lambs were allowed to eat the hay and roots whenever they chose instead of having them fed regularly. The corn and oats were fed whole. The hay used was clover hay of excellent quality. The silage was from corn well glazed at the time of filling, and was cut. The roots were ruta-bagas, sliced before feeding. The lambs were kept in roomy pens in a barn, and were not permitted to exercise in the open air. All the lambs were sheared during the week ending March 8, and they averaged 6.75 lbs. of wool per head, which netted 21 cts. per pound.

The gains and the financial results, allowing 5 cts. per pound for the lambs at the beginning and at the close of the experiment, were as follows:

Summary of results of feeding lambs.

Lot.	Number of lambs.	Ration.	Cost of ration per head daily.	Total gain per lot.	Cost of food per pound of gain.	Financial result. Cost of lambs and food.	Financial result. Receipts for lambs and wool.	Financial result. Average profit per lamb.
			Cents.	*Pounds.*	*Cents.*			
1	10	Corn	2.9	443	5.6	$67.11	$74.45	$0.73
2	10	Oats	2.27	379	7.3	69.42	71.45	.20
3	10	Bran	1.66	242	8.1	61.69	64.10	.24
4	10	Corn and oats	2.25	436	6.1	69.62	74.70	.51
5	10	Corn and bran	2.02	358	6.7	68.07	72.00	.39
6	15	Oats and bran	2.01	541	6.6	99.97	106.14	.41
7	15	Corn, oats, and bran	2.09	581	6.4	101.21	107.75	.44
8	20	Roots	1.89	589	7.6	119.63	124.15	.22
9	20	Silage	1.54	586	6.2	112.80	125.40	.63
10	5	Corn, oats, and bran, "self fed"	2.67	130	8.6	32.71	33.00	.06

In this summary no account is taken of the value of the manure produced or of the labor, except that of shearing.

The average gain per week of all the lambs before shearing was 1.9 lbs. per lamb and after shearing 2.8 lbs. Diagrams are given showing the relation of the gain in weight to the temperature and to the protein and the carbohydrates of the ration, respectively.

The author's summary of the results of the experiment is as follows:

"(1) Lots receiving corn in the grain ration, either in whole or in part, produced the best gains, were apparently in better finish, and in general were fed at a greater profit than the lots receiving bran or oats.

"(2) A grain ration of bran proved to be ani nferior material for fattening lambs.

"(3) A ration of corn and oats produced slightly better results than either a mixture of corn and bran, or of corn, oats, and bran.

"(4) The results of this experiment indicate that the gains resulting from fattening lambs by means of a 'self feed' [lot 10] are produced by a larger consumption of grain for 1 lb. of gain than when fed at regular intervals in the usual manner, and other things being equal the gains are less profitable.

"(5) A mixture of fodder articles composed largely of a good quality of silage proved a cheap and successful ration for fattening lambs.

"(6) The rate of gain was apparently increased by shearing during the fattening period.

"(7) In this experiment colder temperatures were quite generally accompanied by increased gains.

"(8) The amount of available protein in the various rations was apparently a less potent factor in producing gains than the amount of available carbohydrates.

"(9) Small gains are not necessarily unprofitable nor are large gains a sure index of profitable food consumption."

Relative feeding values of timothy, alfalfa, and wild hay, J. W. SANBORN (*Utah Sta. Bul. 29, pp. 15–20*).—Brief mention is made of a trial with 3 lots of steers fed timothy, alfalfa, and wild hay, respectively, for about 5 weeks. The steers were confined in stalls and none of them ate well. All lost weight except the lot on alfalfa hay, which gained 27 lbs.

In a similar trial with sheep confined in small pens the outcome was practically the same, the lot on alfalfa hay being the only one to make any gain in weight.

The feeding value of cowpea hay, R. L. BENNETT and G. B. IRBY (*Arkansas Sta. Bul. 27, p. 79*).—A mixture of 20 lbs. of cowpea hay and 13.6 lbs. of cotton seed per 1,000 lbs. live weight was fed to 2 yearling steers for 37 days and 2 three-year-old steers for 87 days. The yearlings weighed about 475 lbs. at the beginning of the trial and the three-year-olds 946 and 876 lbs., respectively. The yearlings gained 2.6 and 3 lbs. per day, respectively, and the three-year-olds 2.92 and 3.14 lbs.

Narrow vs. wide nutritive rations for horses, J. W. SANBORN (*Utah Sta. Bul. 30, pp. 7*).—This is similar to an experiment reported in the Annual Report of the station for 1892 (E. S. R., 5, p. 77). The wide ration consisted of corn and timothy hay, and the narrow ration of oats, clover hay, and timothy. The nutritive ratio of the former was 1:15.2 and of the latter 1:7.8. These were fed to 2 lots of horses

(number not stated) from October 21 to January 21, the lots being reversed December 13. It is not stated whether the horses were worked. Lot 1 lost on both the narrow and wide rations, the loss being greater on the latter; and lot 2 gained slightly on the wide and lost a similar amount on the narrow ration. The author's summary is as follows:

"(1) Horses receiving corn and timothy did as well as horses fed on oats, clover, and timothy.

"(2) The experiment seems to show that the value of food depends upon the heat units it may furnish in combustion.

"(3) A wide nutritive ration up to 1:15.2 was equivalent to a nutritive ration of 1:7.8.

"(4) A small amount of protein, amounting in the above experiment to 0.82 lb. per day per horse, was as adequate for the horses as double the amount, thus showing that a very small amount of protein per day is sufficient for a working horse."

In the former experiment "corn meal and timothy did not sustain work horses as well as oats, wheat, and clover hay," and "a ratio of 1:14.8 was not as effective as one of 1:5.5."

Feeding experiments with dried-beet residues at Alnarp, Sweden (*Tidskr. Landtmän, 15 (1894), pp. 409–514*).—Twelve Holstein-Friesian cows of about the same age and size and at about the same stage of lactation were separated into 3 equal lots. The cows, which previous to the experiment had been on about the same feed, were fed on the following ration from March 4 to 17: 15 kg. ruta-bagas, 1.5 kg. potatoes, 4 kg. hay, 2.5 kg. wheat bran, 5 kg. ground barley and oats mixed, 0.5 kg. rape-seed meal, 0.5 kg. palm-nut meal, 0.5 kg. sunflower-seed meal, 0.25 kg. peanut meal, and 0.25 kg. cotton-seed meal.

Lot 1 received this ration to the close of the experiment (April 30). From March 17 to April 30 lot 2 received 2 kg. dried beet chips in place of 1.25 kg. wheat bran, and lot 3 received the same quantity of beet chips in the place of 2 kg. of hay. The average live weight of the cows, as well as the quantity and the quality of the milk produced during periods of 10 days, are given.

It appears from the results that 1 kg. of dried beet chips gave fully as good results as the same quantity of medium meadow hay or 0.63 kg. of wheat bran.

Attention is called to the fact that beet chips are very deficient in fertilizing ingredients, containing only 0.3 part of potash, 0.3 part of phosphoric acid, 1.1 part of lime, and 0.1 part of soda per 1,000 lbs. of chips. Especially in case of feeding growing stock or rich milkers demanding large quantities of mineral matter this fact must be born in mind.—F. W. WOLL.

Proteids of the wheat kernel, T. B. OSBORNE and C. L. VOORHEES (*Jour. Amer. Chem. Soc., 16 (1894), No. 8, pp. 524–535*).—Reprinted from report of Connecticut State Station for 1893 (E. S. R., 5, p. 1079).

Crystalline magmas in honey, F. G. WIECHMANN (*Sugar Cane, 1894, pp. 408–410*).—A study of chemical composition.

Ensiling meadow grass and clover, A. APENÄS (*Norsk Landmansblad, 13 (1894), pp. 260–262*).

Recent experience in ensiling grasses in Norway, A. SUNDBY (*Tidskr. norske Landbr., 1 (1894), pp. 198–217*).

Remarks on the heating and spontaneous combustion of hay, BERTHELOT (*Bul. Soc. Chim. Paris, 11–12 (1894), No. 15, pp. 810–812*).

The effect of heat upon the digestibility of gluten, ELLEN H. RICHARDS and ELIZABETH MASON (*Tech. Quart., 1894, Apr., pp. 63–65*).—The results of experiments with acid pepsin solution on commercial gluten tended to confirm Stutzer's statement that heat lessens the digestibility of vegetable albuminoids.

The energy developed by the combustion of albuminoids in the body, C. MATIGNON (*Bul. Soc. Chim. Paris, 11–12 (1894), pp. 568–571*).

Digestion without digestive ferments, A. DASTRE (*Jour. Pharm. et Chim., 30 (1894), ser. 5, No. 4, pp. 167, 168*).

The effect of the hairy coat of animals on the production and radiation of heat, M. RUBNER (*Arch. Hyg., 20, No. 4, pp. 365–371*).—At temperatures of 20 and 25° C. animals shorn of their fleeces produced considerably more heat than under normal conditions. The heat production was not normal under 30° C., so that the coat was considered equivalent to about 10° C.

Practical experience in Germany in feeding corn (maize) to horses, KLOEPFER (*Deut. landw. Presse, 21 (1894), No. 60, pp. 582, 583*).—The experience is given of 26 horse-railway companies in feeding corn as a partial substitute for oats. The corn was cracked in a majority of cases, and in many cases soaked in water before feeding. The experience of 22 companies was very favorable to the corn. It is suggested that the less favorable results in the four other cases may have been due to the method of feeding. The author believes that for horses fully three fourths of the oats may be replaced by corn, and recommends that the corn and oats be fed separately, the corn being soaked in salt water for 24 hours before feeding. American "mixed" corn is preferred to that grown on the Danube or La Platte or in Russia.

Yield of a Norwegian dairy herd, H. O. JÖLBERG (*Norsk Landmandsblad, 13 (1894), pp. 82, 83*).—The record is given for a herd of cows for 10 years, the number of cows in the herd varying during the time between 14 and 22. During this time the average annual yield of milk per cow ranged from 1,597 to 2,470 kg., and the yield of milk per kilogram of live weight 4.33 to 6.6 kg. The individual record for 18 cows in 1893 showed the total milk yield to vary from 1,912 to 3,726 kg., and the yield of milk per kilogram of live weight from 4.4 to 7.3 kg.

The daily ration for the whole herd during 1893 was 419 lbs. hay, 176 lbs. oat straw, 88 lbs. dried brewers' grains, and 35 lbs. rape-seed cake. Calculated per 1,000 lbs. live weight the ration contained 24.10 lbs. of organic matter, 2.04 lbs. of digestible protein, 10.87 lbs. of digestible carbohydrates, and 0.43 lb. of digestible fat; nutritive ratio, 1:6.2. As this feed did not produce an entirely satisfactory flow of milk, 22 lbs. of rye shorts was added during the middle of November.—F. W. WOLL.

A study of the Wahima (Watussi) cattle of Central Africa, L. ADAMETZ (*Jour. Landw., 42, No. 2, pp. 137–156*).

Hog-raising in Denmark, F. HORNEMANN (*Tidskr. norske Landbr., 1 (1894), pp. 186–189*).

The external conformation of the horse, E. A. A. GRANGE (*Michigan Sta. Bul. 110, pp. 67–98, pls. 5*).—A popular article embodying the results of personal observation and of extensive correspondence with horsemen. The qualities desired in the form or character of the ears, poll, forehead, face, nostrils, muzzle, mouth, cheek, eye, intermaxillary space, neck, withers, back, croup, dock, chest, abdomen, skin, legs, feet, color, action, and gait are discussed. Scales of points are given for coach, thoroughbred, and trotting stallions, mares, or geldings; also a record of measurements made on 50 stallions, mares, and geldings at the Columbian Exposition and at the Michigan State Fair.

Live stock and poultry at the Louisiana State Station (*Louisiana Stas. Bul. 28, 2d ser., pp. 975, 976*).—Brief notes on the station herd, a record of eggs laid by 9 breeds of chickens, each represented by 1 to 3 laying hens, and results of weighing chickens of the same breeds. The chickens were 3 months old. Light Brahma gave the heaviest cockerels, followed by Laced Wyandotte; Langshan the heaviest pullets, followed by Light Brahma.

VETERINARY SCIENCE.

Additional investigations concerning infectious swine diseases, T. SMITH and V. A. MOORE (*U. S. Dept. Agr., Bureau of Animal Industry Bul. 6, pp. 117*).—The subjects treated are the following: The hog-cholera group of bacteria; experiments on the production of immunity in rabbits and guinea pigs with reference to hog-cholera and swine-plague bacteria; the variability of infectious diseases as illustrated by hog cholera and swine plague; the effect on the virulence of the bacillus of hog cholera of passing the microörganism through a series of rabbits; the disposal of hog-cholera and swine-plague bacteria injected in small numbers into the subcutaneous tissue of pigs; and the practical bearings of the above investigations.

The authors' summary on the subject of immunity is as follows:

"(1) It is possible to produce immunity toward hog-cholera and swine-plague bacteria in the very susceptible rabbit and the less susceptible guinea pig. In the rabbit the only promising method of immunization toward hog cholera is the use of gradually augmented doses of attenuated cultures.

"(2) Immunization toward swine-plague bacteria is produced artificially with much greater ease than toward hog-cholera bacteria.

"(3) The blood serum of animals protected against hog cholera and swine plague is almost as efficacious in producing immunity soon after treatment as the bacteria products obtained from cultures.

"(4) Different degrees of immunity in both hog cholera and swine plague lead to different forms of the inoculation disease. The greater the immunity short of complete protection the more prolonged and chronic the disease, induced subsequently by inoculation.

"(5) Pathogenic bacteria may remain in the organs of inoculated animals some time after apparently full recovery. Their presence may or may not be associated with lesions recognizable by the naked eye.

"(6) The toxicity of sterilized cultures appears to be directly proportional to the number of bacteria in the injected fluid.

"(7) The results of Selander and Metchnikoff in the immunization of small animals were obtained with swine-plague and not with hog-cholera bacilli."

The following conclusions were reached relative to the disposal of hog-cholera and swine-plague bacteria injected into the subcutaneous tissue of pigs:

"(1) Both hog-cholera and swine-plague bacteria will remain alive in the subcutaneous tissue for several days after their injection.

"(2) The hog-cholera bacteria are taken up from the point of injection and distributed, to a certain extent, through the body. They are harbored for a limited period of time in certain lymphatic glands, where they may be detected. They are not found in the other organs of the body."

"(3) The swine-plague bacteria are not found beyond the tissues immediately surrounding the point of their injection.

"(4) Subcutaneous injection of small doses of either hog-cholera or swine-plague bacteria of ordinary virulence have little, if any, pathogenic effect."

Relative to the practical bearings of these investigations the following statements are made:

"Our observations on hog cholera lead me to believe that even if a fairly successful and cheap method of vaccination against hog cholera could be devised the result would be that a number of animals would contract a chronic type of the disease after infection, and these would have all the objectionable features of worthless animals scattering infection about for months. . . .

"When epizoötics of either disease [hog cholera or swine plague] appear among swine they are due largely to aggravating circumstances, and the removal of these is the key to the prevention of swine diseases. . . .

"More attention should be paid to the effect of food, both in predisposing to hog cholera and swine plague and in producing diseases of the digestive organs which simulate hog cholera, but which are probably quite easily prevented. A thorough study should also be made of lung worms and ascarides. If these difficulties can be removed or mitigated, and if the diseases due directly to improper feeding be eliminated by more careful attention to fundamental principles, it is more than probable that the infectious swine diseases will largely disappear. This prediction is based on the fact, experimentally determined, that swine naturally possess more or less immunity toward both hog-cholera and swine-plague bacteria, and that with vigorous digestion and sound lungs they may be able to resist the infection which can reach them in decently kept surroundings."

On the disappearance of the anthrax bacillus after death, J. McFadyean (*Jour. Roy. Agl. Soc. England, ser. 3, 5 (1894), No. 18, pp. 266–269*).—The author's conclusions are drawn from inoculation experiments with rabbits and sheep and from observations made in the laboratory during the present year. The aërobic anthrax bacillus degenerates and dies as soon as the supply of oxygen is cut off by the death of the animal. Immediately normal putrefactive bacteria invade the carcass. One of these anaërobic putrefactive germs is the so-called malignant œdema bacillus, which in size and shape so far resembles the anthrax bacillus as to be easily mistaken for it.

Within 24 hours after the death of an animal from anthrax the carcass, if left unopened, sometimes contains not a single anthrax bacillus in the organs of the chest or abdomen. However, in the blood of the ears or the feet the bacillus may be recognized on the third day after death. Hence it is recommended that for a suspected case of anthrax a complete post-mortem examination should not be conducted, but that a piece of the ear be cut off and the blood from its veins submitted to microscopic examination.

The author considers that the danger of soil contamination is greater from the bleeding resulting from a post-mortem examination than from the liberation of the bacilli from buried carcasses that have not been opened. When the possibility of spore formation on the part of the anthrax bacilli is prevented by the exclusion of air and by the maintenance of the temperature below 70° F., both of which conditions

are brought about by burial even at a moderate depth, complete putrefaction occurs and the carcass may be considered as innocuous.

Thread worm (Trichina spiralis), F. P. WILLIAMSON (*North Carolina Sta. Bul. 99, pp. 175–179, figs. 5*).—Life history and methods of propagation of the worm, and treatment to cure or to prevent trichinosis.

Report of the veterinarian, S. B. STAPLES (*Louisiana Stas. Bul. 28, 2d ser., pp. 977–981*).—Notes on the work of the station, on glanders, and on the treatment of fistula and of impaction of the stomach.

The prevalence of anthrax in Great Britain, G. T. BROWN (*Jour. Roy. Agl. Soc. England, ser. 3, 5 (1894), No. 18, pp. 265–271*).

The occurrence, diagnosis, and preventive and remedial treatment of tuberculosis in animals, II, III, and IV, G. SCHNEIDEMÜHL (*Fühling's landw. Ztg., 43 (1894), No. 14, pp. 448–454; No. 15, pp. 461–466; No. 17, pp. 525–532*).—Popular.

Contribution to the study of trichina, CERFONTAINE (*Arch. Biol. 13, No. 1, p. 125; abs. in Centbl. Bakt. u. Par., 16 (1894), 7, pp. 311, 312*).

Milk fever, O. THESEN (*Tidskr. norske Landbr., 1 (1894), pp. 179–186*).

The Bhakha plant (Indigofera cordifolia) and its effects on cattle, J. INDRAJI (*Jour. Bombay Nat. Hist. Soc., 8 (1894), No. 3, pp. 444–447*).—Description of plant and notes on cases of diarrhea in ruminants supposed to be caused by it.

A disease of ring doves, E. LECLAINCHE (*Ann. Inst. Pasteur, 8 (1894), No. 7, pp. 490–494*).—Inoculation experiments with bacteria found in diseased ring doves.

Some biological variations of Pneumobacillus liquefaciens bovis, S. ARLOING (*Compt. Rend., 119 (1894), No. 3, pp. 208–210*).—A discussion of 2 varieties of this organism.

DAIRYING.

Test of cream separators, H. H. WING (*New York Cornell Sta. Bul. 66, pp. 161–174, pl. 1*).—In connection with the dairy school, tests were made of the following separators: Sharples Standard Russian, Victoria, De Laval Alpha No. 1, De Laval Alpha Baby No. 3, Columbia No. 1, Butter Accumulator, and United States Extractor-Separator No. 3. The working of the Sharples Imperial Russian Separator was also observed at a factory where it was in operation. The capacity of the separator was observed in each case, and the percentage of fat in the skim milk was determined gravimetrically. All the runs were short, especially for the machines of larger capacity, which made it difficult to accurately estimate the capacity of the machines. In addition to tests of the efficiency of the separators, determinations were made by the mechanical department of the university of the power required for running the different separators. A summary of the results, showing the

number of runs, the capacity, the percentage of fat in the skim milk, and the power required is given in the following table:

Summary of tests of separators.

Kind of separator.	Number of runs.	Fat content skim milk.	Rated capacity per hour.	Separated per hour in efficiency test.	Separated per hour in power test.	Horse power required.	Estimated horse power required to separate 1,000 lbs. per hour.
		Per cent.	*Pounds.*	*Pounds.*	*Pounds.*		
Sharples Standard Russian	20	0.29	1,200	1,112	1,287	4.00	3.13
Sharples Imperial Russian	5	0.20	2,000	1,900			
Victoria (75 gal.)	12	0.19	625	737	702	1.95	2.78
De Laval Alpha No. 1	14	0.10	2,000	1,471			
De Laval Baby No. 3	17	0.17	600	571	582	0.15	0.26
Columbia No. 1	17	0.13	300	318	353	1.12	3.17
Butter Accumulator[1]	9	0.13	600	416	240	1.12	2.69
United States Extractor-Separator[1]	10	0.12	600	658	582	0.44	0.76

[1] Run as separator.

"[Sharples Standard Russian separator] is extremely simple and easily run. Taking care that the boiler pressure was always 20 to 40 lbs. above the required pressure upon the turbine we found that the speed of the bowl was very uniform. No difficulty was had in getting cream of any desired thickness, and the cream came from the machine smoothly and uniformly and several degrees cooler than the milk entered.

"On scarcely any occasion was [the De Laval Alpha separator] run to its full capacity. This was not due to inability to get the milk through the machine, but largely to the shortness of the runs. . . . On the occasion where 1,800 to 1,900 lbs. of milk were run through, there was no more fat in the skim milk than when a less amount was run. In the four highest runs the average amount of milk separated per hour was 1,800 lbs. with 0.11 per cent of fat in the skim milk. In the four smallest runs the amount of milk separated per hour was 1,150 lbs., with also, 0.11 per cent of fat in the skim milk. . . . The character of the cream as to density and consistency was also all that could be desired.

"[De Laval Baby No. 3], so far as condition of cream and other details of operation were concerned, was perfectly satisfactory. . . .

"The peculiarity of [the Columbian] is that the bowl is made of aluminum and is much lighter than other bowls of the same capacity. It delivered the cream in very good condition and at a temperature lower by several degrees than the milk entered, but it was not found possible to get cream of a greater fat content than 18 per cent without materially increasing the percentage of fat in the skim milk. We are informed by the manufacturers that this difficulty has been obviated in the machines now made, but we have not yet had an opportunity to make a test. . . .

"[The butter accumulator] worked perfectly satisfactorily as a separator in all respects, except that a very heavy cream could not be obtained without cutting down the capacity. [The fat content of the cream ranged from 11 to 22 per cent.] . . . In the case of the other machines . . . the fat in the cream ran uniformly between 25 per cent and 30 per cent.

"We have also used the accumulator as a butter machine [but] we have not been able to obtain uniformly so good results in texture of butter, mainly, we think, because of the extremely delicate adjustment of the inflow that is necessary. . . .

"The operation of the extractor-separator was thoroughly satisfactory in all respects so far as mechanical operation and condition of cream were concerned. . . .

"[In regard to the amount of power required] the above results show a somewhat

surprising variation in the mechanical efficiencies of the separators tested. The power required to drive two of the machines [the Baby and Victoria separators] of not very different capacities, is seen to be 0.15 and 1.95 horse power, respectively, a variation large enough to arouse a suspicion as to the accuracy of the results, were it not that the other tests show a gradation in power required between these two values.

"The friction of the machine is seen to absorb in each case the major portion of the power expended, while the actual work in separating the milk appears to be roughly proportional to the weight separated. The work done in separating is about 0.07 horse power per 1,000 lbs. per hour.

"A noteworthy conclusion to be drawn from the test is, that the geared form of separator is much more efficient than the belted form. This may be due in part to slipping of the belts at the high speed used. Much work is also absorbed in bending the belt as it passes around the small pulleys.

"It may also be noted that the two machines in which rope belts were used were considerably more efficient than the one in which a leather belt was employed between the intermediate and the machine."

The Babcock test as a basis for payment in cream-gathering creameries, A. L. WINTON and A. W. OGDEN (*Connecticut State Sta. Bul. 119, pp. 24, fig. 4, pl. 1*).—This is an account of tests of the present method of paying for cream in cream-gathering creameries by the space as compared with paying for it on the basis of its composition as shown by the Babcock test. The practice of patrons of these creameries is to set their milk in deep, submerged cans which are skimmed by the cream-gatherer, who reads off the number of spaces of cream on the cans before skimming. Payment is made by the space without regard to composition. The cream furnished by each of the patrons of 4 cream-gathering creameries was sampled and tested and a record made of the number of spaces furnished. From these data and the ruling price for cream per space, the calculations were made of the value, according to test and according to the old method, of the cream furnished by each patron. The unfairness of the old system was shown by the fact that the cream collected contained all the way from 7.25 to 24.5 per cent of fat; and that from 4.72 to 11.72 spaces of cream were required to make 1 lb. of butter.

"Even when the directions of the makers of the apparatus and of the creamery manager are closely followed the cream raised from the milk of one and the same herd, which is fed, handled, and milked as uniformly as possible, will yet show moderate differences in the quantity of butter-fat present per space from day to day.

"The time which elapses from the setting to the skimming of the milk has considerable effect on the number of spaces gathered. For a certain time after setting, the depth of the cream layer and the number of spaces increase; then follows a period during which the number of spaces slowly decrease, on account of the coalescence of the fat particles, but the per cent of butter-fat and with it the value of the cream for butter-making is nevertheless all the while increasing.

"But when the prescribed method of setting is not closely followed by a part of the patrons differences in the quality of the space become so large as to work great injustice to other patrons and generally to those who are producing the most and the best cream."

The station has worked out a system for paying for the cream by the Babcock test, which has been adopted by a creamery in this State.

This system and the method of sampling and testing the cream are fully described and illustrated. It is in brief as follows: The cream skimmed by each patron is weighed by the cream-gatherer, who also takes a sample, by means of a sampling tube, accurately representing the entire cream both as to its quantity and its quality. A composite sample is made of each patron's cream gathered from day to day, which is kept from curdling by adding bichromate of potash, and is finally tested by the Babcock method.

From the total weight of cream gathered and the per cent of fat in it the actual weight of butter-fat furnished by each patron is determined and placed to his credit. Spaces are not taken into account.

Alkaline tablets for testing the acidity of cream, E. H. FARRINGTON (*Illinois Sta. Bul. 33, pp. 399, 400*).—This refers to a matter of detail in testing the acidity of cream by means of alkaline tablets, as described in Bulletin 32 of the station (E. S. R., 6, p. 83). It is suggested that 5 tablets be dissolved in water in a 50 cc. graduated cylinder, and the solution added to 25 cc. of cream until there is a permanent pinkish color. The quantity required indicates the acidity of the cream. The tablets are composed of definite quantities of sodium carbonate and phenolphthalein.

Experiments in churning cream with the addition of hydrochloric acid, HITTCHER (*Milch. Ztg., 23 (1894), No. 27, pp. 425–427*).—Mention was recently made (E. S. R., 6, p. 167) of a method patented in Germany of souring cream by the addition of hydrochloric acid, instead of allowing it to ripen by fermentation. To test the value of the method, 26 trials were made, at the suggestion of Dr. Fleischmann, between March 21 and May 26. The fresh separator cream was cooled and run directly into a vat, where it was mixed with hydrochloric acid until it had the desired acidity (to the taste). The amount added was regulated wholly by the acid taste, but, on an average, 5.5 cc. of acid (containing 27.6 per cent HCl) was added per liter of cream. After thorough stirring, the cream was churned without delay. As the cream as it came from the separator had a temperature of 60 to 70° C., and was consequently pasteurized, trials were made with other cream not pasteurized, and 3 trials were made with cream which was 24 hours old. About 300 lbs. of cream was taken for each trial.

The time required for churning depended largely on the speed, but averaged about 26 minutes, at a temperature of about 50 to 60° C. More time was required for the cream 24 hours old than for that fresh. There was no difference between pasteurized and nonpasteurized cream. The percentage of fat in the buttermilk varied from 0.23 to 0.72 and averaged 0.51 per cent. From 96.18 to 99.21 per cent of the fat in the cream was recovered in the butter, with an average for all the trials of 98.07 per cent. The butter worked once averaged 13.85 per cent of water, and worked twice and salted 11.87 per cent. In 20 cases out of the 26 trials the butter as it was taken from the churn was in normal condition,

and in the remaining cases it was oily or very finely granulated. Determination of casein in 6 samples of butter showed from 0.62 to 0.67 per cent, which is not considered higher than that in ordinary butter.

In taste the butter could hardly be told from other butter by experts, although some remarked the lack of the aroma characteristic of sour-cream butter. Its keeping qualities can not be pronounced upon yet.

The buttermilk had a sour taste and was easily distinguished from ordinary buttermilk. As a rule, it was not as well liked.

The method is believed by the author to possess certain advantages and to be worthy of trial. It has been adopted at the creamery where the above tests were made.

The artificial souring of cream, H. HÖFT (*Milch Ztg., 23 (1894), No. 29, pp. 464, 465*).—This article, like the preceding, deals with the use of hydrochloric acid for souring cream. The trials were made in much the same way, except that the acid was added until the cream had an acidity of 70° (Thörner). No data are given as to the losses in churning. The taste and general qualities of the butter were not affected by the use of the acid, but the taste of the buttermilk was injured. This was corrected in a measure by adding carbonate of soda (100 gm. to 100 liters of buttermilk) and some skim milk.

It is cautioned that only pure acid should be used, as crude hydrochloric acid contains arsenic. Nothing is said of the keeping qualities of the butter.

Effect of milk on cholera bacilli, W. HESSE (*Ztschr. Hyg., 17 (1894), p. 238; abs. in Chem. Ztg., 18 (1894), No. 52, Repert., p. 163*).—A long series of experiments leads the author to state that fresh, uncooked cows' milk is not a medium for the growth of cholera germs, as when introduced into it they die in about 12 hours at room temperature, and in about 6 to 8 hours in the breeding oven. He believes this is not due to an acidity of the milk or to the presence of other germs. Milk which was subjected to the action of live steam for 3 hours or more was also not a good medium for cholera, but that treated for a short time was found to be.

Concerning the behavior of cholera germs in milk, H. WEIGMANN (*Milch Ztg., 23 (1894), No. 31, pp. 491–493*).—The author discusses this question in the light of the data at hand, including Hesse's studies mentioned above, and some additional experiments of his own. His experience confirms that of Hesse that raw milk is not a good nutritive medium for the growth of cholera bacilli, and he finds that the length of time they are able to live in it depends upon the numbers in which they are present. He still believes that there is danger from cholera infection through milk, although he regards the danger as much less than was formerly believed to exist.

A study of organisms found in sterilized milk (*R. Soc. Ital. Igien., 16 (1894), No. 1; abs. in Staz. Sper. Agr. Ital., 26 (1894), No. 5, pp. 545–547*).

The relation of the color of milk to its fat content, N. JENSEN (*Mälkerei Tidende, 7 (1894); Nord. Mejeri Tidn., 9 (1894), p. 284*).

Exhaustiveness of churning cream, E. H. FARRINGTON (*Amer. Agr., 1894, Aug., p. 426*).—Suggestions as to the temperature to be maintained in order to get best results in churning different kinds of cream. It is claimed "that within certain limits the thickness of the cream and the temperature at which it is churned have more influence on the exhaustiveness of churning than does the acidity or sourness of the cream."

Milk testing and payment for milk by results, C. C. LANCE (*Melbourne: Titherleigh & Bayne, 2d ed.; noticed in Chem. News, 70 (1894), No. 1809, p. 47*).

Some recent methods and apparatus for the examination of the fat content of milk by means of centrifugal force, J. SEBELIEN (*Norsk Landmandsblad, 13 (1894), pp. 219–223*).

Babcock's milk test, F. H. WERENSKIOLD (*Norsk Landmandsblad, 13 (1894), pp. 263, 264*).

Certified tests of dairy cows, G. E. MORROW (*Illinois Sta. Bul. 33, p. 400*).—The station offers to supervise tests of dairy herds in the State under certain conditions, which are stated.

Preservation of milk for purposes of analysis, M. KÜHN (*Molk. Ztg., 8 (1894), No. 24, p. 354*).—Trials were made with borax, boracic acid, salicylic acid, fluorin compounds, and bichromate of potash. Of the fluorin compounds the sodium fluorid was the most promising. The bichromate was satisfactory, especially when the milk was kept in a cool place.

Test of milk by pressure, R. LEZÉ and E. HILSONT (*Jour. Pharm. et Chim., 30 (1894), ser. 5, No. 4, pp. 178–180*).—Tests principally of the relation of pressure to coagulation.

The milk supply of Berlin, B. MARTINY (*Berlin: Deut. Landw. Gesell., 1894, pp. 18, map 1*).—Gives statistics as to the supply of Berlin with milk, the source of the supply, and a map showing the amounts of milk brought by rail from different directions.

The importance of bacteriology in cheese-making, F. J. HERZ (*Abs. in Chem. Ztg., 18 (1894), No. 44, Repert., p. 143*).

Swedish butter exhibitions (*Tidskr. Landtmän, 15 (1894), pp. 170, 171*).—Butter exhibitions were held in Malmö February 19, 1894, and in Gothenburg January 22 and February 12, 1894. Fifty-five creameries and private dairies took part in the first-mentioned exhibition and 47 in the last one. The average scoring of the butter on a scale of 12 points and the water content of the butter were as follows:

Scoring and water content of butter exhibited.

	Scoring of butter.				Water content of butter.		
	Average for all.	Private dairy.	Coöperative creamery.	Proprietary creamery.	Average.	Highest.	Lowest.
	Points.	*Points.*	*Points.*	*Points.*	*Per cent.*	*Per cent.*	*Per cent.*
Malmö	11.3	12.2	11.4	11.3	14.64	17.65	11.53
Gothenburg	10.9	11.2	10.6	10.6	13.47	20.22	10.62
Do	11.4	11.6	11.5	11.2	13.29	15.66	10.33

—F. W. WOLL.

TECHNOLOGY.

Studies on alcoholic fermentation, N. VON CHUDIAKOW (*Landw. Jahrb., 23, No. 2 and 3, pp. 391–534*).

The temperature of fermentation in Algeria, J. DUGAST (*Agr. Prat., 58 (1894), No. 35, pp. 315–320*).—An article on the best temperature for wine-making.

Mannitic fermentation of wines in Sicily, G. BASILE (*Staz. Sper. Agr. Ital., 26 (1894), No. 5, pp. 451-497*).—A study of the conditions under which it occurs, with analyses of wines.

The use of selected yeasts in wine-making, C. FABIE (*Compt. Rend., 119 (1894), No. 6, pp. 373-375*).—These yeasts produce fine wines only when used in must prepared from grapes thoroughly acclimated in the region from which the yeasts are derived.

The oxidation of beer wort, P. PETIT (*Compt. Rend., 119 (1894), No. 5, pp. 342, 343*).

Cost of sugar production in British Guiana (*Sugar Cane, 1894, pp. 435-437*).

Indian tanning materials, D. HOOPER (*Amer. Jour. Pharm., 24 (1894), No. 8, pp. 377*).—The percentages of tannin in 63 tanning plants are given.

Progress in tanning and in tanning materials, J. PÄSSLER (*Chem. Ztg., 18 (1894), No. 65, pp. 1240-1245*).

Improvements in the sulphuric acid industry, P. DE BOISSIEN (*Bul. Soc. Chem. Paris, 11-12 (1894), No. 14, pp. 726-729, figs. 2*).—A discussion of Barbier's apparatus.

Central American rubber (*Roy. Bot. Gard. Trinidad, Misc. Bul. No. 23, pp. 282-287*).—Descriptive notes and popular information are given regarding the Central American rubber, *Castilloa elastica*.

AGRICULTURAL ENGINEERING.

Amount of water to be used in irrigation, J. W. SANBORN (*Utah Sta. Bul. 29, pp. 1-13*).—Experiments with grain, commenced in 1890 and reported on in Bulletin 24 of the station (E. S. R., 5, p. 414), were continued in 1893 on wheat, and for comparison similar experiments on timothy were also carried out. On the wheat water was applied at rates sufficient to saturate the soil to depths of 4, $3\frac{1}{2}$, $2\frac{1}{2}$, 2, $1\frac{1}{2}$, and $\frac{3}{4}$ ft., and on timothy at the first five of these rates. The data tabulated and discussed include the chemical composition of the water applied and the drainage collected in each case; the temperature of the soil at depths of 1, 2, and 3 in., and of the air above the soil at heights of 3, 6, and 12 in.; the moisture content of the soil at depths of 2 and 8 in. from 4 to 16 days after irrigation, and the yield of crops. The results are thus summarized:

"(1) The plants on soil saturated to the depth of $1\frac{1}{2}$ ft. gave a better crop of grain than those on soil receiving a greater or less amount of water.

"(2) For timothy, the plats saturated $2\frac{1}{2}$ ft. deep gave the best results.

"(3) Soils remove most of the solids from water applied beyond soil saturation.

"(4) The water that does escape from soils by leaching is richer in the elements of fertility than before it entered, the amount so escaping, however, being so small that the total contains but a fraction of the solids applied.

"(5) Where water applied is small in amount, the temperature grows higher and higher on decreasing amounts.

"(6) Water applied to our gravelly soils appears to evaporate inside of 12 days."

Mulching, J. W. SANBORN (*Utah Sta. Bul. 31, pp. 7-15*).—The results of experiments on potatoes of mulching irrigated and unirrigated plats to ascertain the value of mulches for reducing the amount of irrigation required are reported in tables. On account of the fact that the "experiment was laid out on a section where the rock subsoil comes near the surface, the results have been disappointing, and in fact practically valueless."

A proposed formula for white pine posts, J. H. STANWOOD (*Tech. Quart.*, *7 (1894), No. 1, pp. 66–69.*)—Formulas and tables giving strength for timbers of different sizes.

On the application of electric plants on farms (*Tidskr. Landökon.*, *13 (1894), pp. 365–382*).—Committee report of the Royal Agricultural Society of Denmark.

Agricultural implements, A. DEBAINS (*Nantes: 1894*).—The implements discussed in this volume are cultivators, harrows, rollers, manure spreaders, and seeders.

Tests of harvesters, E. GIESELER (*Deut. landw. Presse*, *21 (1894), No. 60, pp. 585, 586*).—A record of draft, width of cut, and height of stubble, for 4 machines, with notes on character of work.

A test of binding twine, RINGLEMANN (*Jour. Agr. Prat.*, *58 (1894), No. 29, pp. 86–88*).—A report of breaking tests of twine made of hemp, jute, manila, and ramie.

Experiments with plows at Nancy, France, I, RINGLEMANN (*Jour. Agr. Prat.*, *58 (1894), No. 30, pp. 125–130, figs. 6*).—A study of the draft of plows with 2 shares and of subsoil and riding plows.

A fruit-packing house (*Fla. Farmer and Fruit Grower, n. ser.*, *6 (1894), No. 33, pp. 515, 516, figs. 2*).—Illustrated description and plan of a house for the commercial packing of fruits.

Stack frame for curing and storing cowpea hay, R. L. BENNETT and G. B. IRBY (*Arkansas Sta. Bul. 27, pp. 73–78, fig. 1*).—Description of a permanent device for this purpose.

STATISTICS.

Bulletins of Arkansas Station (*Arkansas Sta. Bul. 27, pp. 84, 85*).—A list of the bulletins published by the station since July, 1891, with the subjects treated.

Reports of director and of treasurer of Kentucky Station (*Kentucky Sta. Rpt. 1890, pp. 6–8*).—Brief remarks by the director on the work of the station, and a report by the treasurer for the fiscal year ending June 30, 1890.

NOTES.

ILLINOIS STATION.—G. E. Morrow's resignation of his positions in the Station and College of Agriculture of the University of Illinois took effect September 1. E. H. Farrington has resigned as chemist of the station to accept the position of associate professor of dairy husbandry at the University of Wisconsin.

MISSISSIPPI STATION.—E. R. Lloyd has been made assistant director, vice W. L. McGee, who is now connected with the South Carolina Station. W. R. Perkins has been appointed assistant chemist, vice L. G. Patterson, resigned; and J. S. Moore has been appointed assistant to the director.

NEBRASKA STATION.—Special work is being done by Prof. O. V. P. Stout, of the university, in gauging the streams of the State; in collecting data relative to the water supply of the State for irrigation, (1) in the streams and (2) in the underflow; and in investigating the means for getting the water upon the land cheaply and effectively.

NEW YORK CORNELL STATION.—Prof. H. H. Wing is no longer deputy director and secretary of this station, but he still holds his position as experiment station worker.

OHIO STATION.—A barn covering about 10,000 square feet, a tool house, and a dairy house are being built at the station. Miss B. E. Wildman has resigned her position as bursar to the station and treasurer to the board of control, and P. A. Hinman, of Cleveland, has been appointed her successor. W. G. Harry, recently a student in the dairy school of the University of Wisconsin, has been appointed dairyman in the station.

UTAH STATION.—J. A. Widtsoe has been appointed station chemist.

WASHINGTON STATION.—A silo with a capacity of 65 tons has just been finished, and a brick root house with an implement room in the second story and a greenhouse 16 by 100 feet are now being constructed. Extensive experiments are being carried out in feeding hogs with wheat. The preliminary results of analyses of samples of sugar beets grown in the State are very satisfactory.

AMERICAN FORESTRY ASSOCIATION.—This association held its summer meeting at Brooklyn, New York, August 22. Prof. Smock, State geologist of New Jersey, read a paper on the forests of that State and J. Gifford read one on forest fires in the same State and the methods of their prevention. Prof. F. H. King, of the Wisconsin Station, gave the results of his personal observations on the destructive effects of drying winds and the protection to crops afforded by woodlands and wind-breaks. Mr. Putnam, of Wisconsin, in treating of Western pine timber lands proposed the establishment of State reservations in Wisconsin by the cession on the part of the lumbermen of pine lands which have been cut over by them. An interesting account of the petrified forests of Arizona was given by H. C. Hovey, with lantern slide illustrations. These forests, it seems, are being ruthlessly destroyed, and Mr. Hovey urged that they should be acquired by the Government and preserved.

The Association improved the occasion to reiterate its views in regard to the preservation of the public forests, and passed a resolution commending the action of the Public Lands Committee of the House of Representatives at the recent session of Congress in urging the passage of a bill for the protection of the public timber lands. This bill, which unfortunately has not yet been put upon its passage, not only provides for the care and protection of the reservations and other public

forests from the depredations of thieves and other injuries, but admits under proper restrictions the fullest use of the timber thereon for the benefit of those needing it for building and other purposes.

Upon the invitation of the New Hampshire Forestry Commission the Association at the close of its meeting in Brooklyn made an excursion to the region of the White Mountains, where the forest conditions of that region were carefully observed and public meetings were held in a number of places, in which the objects and results of rational forestry were discussed.

PERSONAL MENTION.—The following notes are taken from the *Landwirtschaftlicher Versuchs Stationen*: Prof. H. Birner, for many years director of the experiment station at Regenwalde in Prussia, died April 19, 1894, at the age of 74 years.

Prof. Emil von Wolff, of the Hohenheim Station, will retire from active service October 1, after 40½ years of labor at Hohenheim. He is now in his seventy-sixth year.

Dr. E. Güntz, director of the Danzig Station, has resigned his position, and Dr. C. Pingel, an assistant, has been appointed to fill the vacancy.

EXPERIMENT STATION RECORD.

VOL. VI. NO. 4.

The British Board of Agriculture has recently issued the first number of a quarterly publication, which is entitled the Journal of the Board of Agriculture. This journal will contain information as to the condition of agriculture in the colonies and abroad, accounts of investigations at experiment stations and similar institutions in Great Britain and elsewhere, notices of innovations in the system of cultivation and of improvements in methods of marketing and distributing, notes on crop prospects in different countries, descriptions of insects, fungi, and other farm pests, and especially agricultural statistics. The material in the first number is grouped under nineteen chapters, one of which is devoted to abstracts of parliamentary publications dealing with agriculture. This journal, like other official publications of the British Government, will be placed on sale, the price for each number being sixpence. Advertisements are also admitted as in private journals.

Now that the low price of wheat has led to the desire for reliable information as to its nutritive value for farm animals, it is unfortunate that we have no reliable data as to the digestibility of this cereal. Analyses of the whole and different parts of the grain are quite numerous, but neither the compilations of digestion coefficients of Wolff, Kühn, Dietrich and König, Jordan, or Lindsey contain any coefficients for wheat. In Dietrich and König's extensive work on composition and digestibility of feeding stuffs, issued in 1891, the relative amounts of digestible components are computed for winter and summer, and for flinty and mealy wheat. Calculation shows that the following coefficients of digestibility were used in computing these amounts: Protein 87, fat 80, nitrogen-free extract 95, and fiber 55.8 per cent. The authors state that in the case of feeding stuffs whose digestibility is as yet undetermined the digestion coefficients for other feeding stuffs of similar nature and composition were used. But the above coefficients for wheat do not correspond to those for any other cereal or for corn. The coefficient for protein is about 10 per cent in excess of that for barley, corn, or oats. The figures used correspond more closely to those for certain leguminous seeds. Unfortunately we have no coefficients for rye, which, on account of its similarity to wheat, would be a helpful guide. In calculating the digestible nutrients in this material Dietrich and König use the same coefficients as for wheat. The tables giving the proportions of albuminoid and non-albuminoid nitrogen in

the protein show that in wheat 88.8 per cent of the nitrogen exists as albuminoids; in rye, 90.6 per cent; in barley, 97.4 per cent; in oats, 94.2 per cent, and in corn 93.3 per cent, indicating codsiderable difference between the protein of wheat and rye and of barley, oats, and corn, which may not be without effect upon its nutritive value.

It is but fair to assume that the eminent authorities who have given us this elaborate and painstaking compilation had good reason for adopting the figures used for wheat and rye, but in the interest of agricultural science our knowledge should be more definite and complete. The value of wheat as a food for nearly all kinds of farm animals has been abundantly demonstrated from a practical standpoint. But the method of feeding varies greatly, and it is impossible to calculate with certainty the amounts of digestible nutrients which a wheat ration contains. What is now needed is information that will show how it can be best compounded into rations for different purposes, and for this purpose exact knowledge as to the digestibility of its constituents is essential.

The results of field experiments with fertilizers are so liable to misinterpretation that the necessity for the careful statement and explanation of such experiments is increasingly evident to every thoughtful student of the literature of agricultural investigation. The difficulty of making suitable reports of fertilizer experiments is greatly increased because of the eagerness with which unscrupulous manufacturers of fertilizers seize upon unguarded or incidental statements in station publications and use them for advertising purposes to the injury of the general public and to the disadvantage of the stations. This unwarranted use of station publications is well illustrated by the circular of a fertilizer dealer recently called to the attention of this Office, in which a brief statement in one of the station bulletins regarding the beneficial effect of soft Florida phosphate observed in a single experiment on peas was distorted into an "official" indorsement of a "natural plant food" fertilizer composed of soft phosphate and glauconit. It is of course impossible, even with the utmost care, to entirely prevent such dishonest practices, but it will be wise to take this danger into consideration when reporting the results of experiments, and guard against unqualified statements which may be caught up by dishonest individuals to mislead the unwary, with the result of casting upon the stations the odium of being parties to the fraud.

In this connection it may be well to add that as the influence of the station increases it will undoubtedly be more and more important that all officers connected with these institutions shall avoid even the appearance of relations with manufacturers of fertilizers or other agricultural commodities which might in any way compromise the stations. It is very doubtful whether the stations do wisely in publishing any information which, though it may be of temporary advantage to farmers, can be construed as an advertisement of private interests.

EIGHTH ANNUAL CONVENTION OF THE ASSOCIATION OF AMERICAN AGRICULTURAL COLLEGES AND EXPERIMENT STATIONS.

The eighth annual convention of the Association of American Agricultural Colleges and Experiment Stations was held at Washington, D. C., November 13–15, 1894, the sessions being held, with few exceptions, in the lecture room of the Cosmos Club. There were present about 100 delegates and visitors, representing agricultural institutions in 37 States and Territories. Several institutions were represented by trustees or members of boards of control, in addition to their presidents or directors.

In the absence of President S. D. Lee, of Mississippi, who was kept away by illness in his family, Vice-President Morrow, of Illinois, presided at the general sessions.

The report of the executive committee, submitted by the chairman, H. E. Alvord, reviewed the work of the committee during the year and called attention to some important matters which demanded the attention of the convention.

The report of the treasurer, M. A. Scovell, of Kentucky, showed the finances of the association to be in good condition, a large majority of the institutions entitled to membership having responded to the increased assessment ($15) rendered necessary by the unusual expenses of the past year in connection with the Columbian Dairy Test. The assessment for the present year is fixed at $10, as heretofore.

The president's annual address was delivered by Vice-President Morrow. He discussed in a thoughtful manner agricultural instruction and investigation at the institutions represented in the Association, and made numerous suggestions based on his experience in these lines of work.

The attention of the convention having been called to the variation in the entrance examinations and courses of study in different agricultural colleges, a committee, consisting of Messrs. G. W. Atherton, A. W. Harris, T. F. Hunt, J. M. McBryde, and C. S. Murkland, was appointed by the chair to take this matter into consideration and report at the next annual convention.

The amendment to the constitution, providing for a change of name of the Association, proposed at the last meeting, precipitated a lively discussion which brought out great diversity of opinion regarding this

subject. A motion to lay the matter on the table was carried by a large majority. President Silvester, of Maryland, however, brought up the subject at a subsequent meeting, in order that it might be again laid before the Association at its next annual convention.

The discussion in connection with the proposed change of name of the Association showed a rapidly-growing interest in mechanical instruction in the land-grant colleges. President J. K. Patterson, of Kentucky, urged the necessity for increased facilities for instruction in this line, and maintained that the mechanics and artisans, who largely represent the explosive elements of our society, really have more need of education than the more conservative farming element. A thoughtful and very practical paper on mechanical instruction in agricultural colleges, by W. E. Drake, of Rhode Island, presented from the section on mechanic arts, was well received.

Prof. J. W. Hoffman, director of the agricultural department of the Tuskegee Institute, Alabama, explained to the convention what this institution is doing for the colored farmers of Alabama in the way of training in industrial lines, practical advice at agricultural conferences, and moral uplifting. President Broun, of the Alabama College, highly commended the work done at Tuskegee.

Hon. W. T. Harris, U. S. Commissioner of Education, spoke of the need of improved methods of teaching agriculture, and of the desirability of specializing and adapting agricultural training to the varying needs and capacities of different minds. He also urged the necessity of reducing agricultural instruction to a pedagogic system like that followed in philosophy, language, etc.; and commended the practice of giving fellowships to encourage original investigation in advanced lines.

Dr. A. C. True, director of this Office, briefly reviewed the work of the Office during the year. He also suggested some ways in which the management of the experiment stations might be improved, especially urging that each station should be conducted as a unit under the direction of an executive officer with full powers and responsibility.

The cordial invitation of Prof. Dr. Nobbe to workers in agricultural science in this country to attend the meetings of the German Association of Agricultural Experiment Stations was acknowledged in an appreciative resolution, in which a similar invitation was extended to members of the German association. By a resolution introduced by Director J. A. Meyers, of West Virginia, the agricultural institutions of the Dominion of Canada were invited to send representatives to the conventions of the Association.

The following resolution, drafted by Prof. H. C. White, of Georgia, regarding the supervision of expenditures of stations receiving Federal appropriations, was adopted after some discussion:

Resolved, That this Association heartily approves the recent legislation by Congress giving the Secretary of Agriculture a measure of supervision over expenditures of the stations.

Resolved further, That this Association indorses the scheme of financial statement adopted by the Secretary of Agriculture, and will approve and welcome the closest scrutiny of the work of the stations by the Department of Agriculture, either by personal visitation of an agent of the Department or such other method as the Secretary of Agriculture may deem most efficient.

Hon. J. Sterling Morton, Secretary of Agriculture, attended one of the meetings of the convention and delivered a brief address, in which he expressed his hearty approval of the good work done by the agricultural colleges and experiment stations. He urged the study of forestry at all agricultural colleges; and announced his intention of recommending to Congress an increased appropriation to each experiment station for the purpose of purchasing, testing, and distributing new and improved varieties of seeds, plants, etc. In a resolution introduced by President H. H. Goodell, of Massachusetts, the Association promised coöperation with the Secretary of Agriculture in this matter.

Dr. C. W. Dabney, jr., Assistant Secretary of Agriculture, addressed the convention briefly, referring to the proposed plans of the Department relating to the supervision of station accounts, and calling attention to the new lines of investigation undertaken in the study of soils and grasses, for which new divisions have been created in the Department. Statistics were presented to show that a higher percentage of the total expenditures of the Department is now being devoted to purely scientific work than ever before in its history. Although in the fiscal year ending June 30, 1894, the total expenditures in the Department were about $405,000 less than in the preceding year, the amount of money devoted to scientific work in the Department was only $1,500 less. The saving had therefore been made in administrative work. But the figures showed that, in spite of the great reduction in the expenses of this feature of departmental work, its efficiency had not been impaired.

Four subjects were presented by the section on agriculture and chemistry for discussion in general session. The discussion on the attitude of agricultural colleges toward university extension was opened by Prof. E. B. Voorhees, of New Jersey, who explained the courses of university extension lectures given in that State. There are 6 lectures each on (1) soils and crops, (2) feeding of plants (use of fertilizers), and (3) animal nutrition. During the past year these lectures were delivered in 7 different sections of the State. The attendance varied from 26 to 109, the average being 60. Out of the 60, 22 took the regular work in connection with the lecture course. It was found that those who began with the first lecture were much more interested than those who started in with later lectures. Men of 25 years and older "seemed to care very little except to hear the lectures and to pick up information for use in regular work." The lectures therefore appealed principally to young men. The lectures have proved of great value in stirring up interest and in bringing young men to the educational institutions of the State.

The subject of coöperation of stations with farmers' organizations in experiment work was formally discussed by Dr. E. H. Jenkins, of Connecticut, and F. E. Emery, of North Carolina. Dr. Jenkins pointed out the difficulty of adopting a plan for such work that will suit all cases, but he maintained that "whenever there is an opportunity for coöperation with farmers' institutes, agricultural societies, or granges it should be heartily welcomed by stations as affording an opportunity to enlist the sympathy and interest of farmers, to extend the sphere of usefulness of the stations, and also to accomplish some work which will be of scientific value; but that stations should not undertake any work at the invitation of any farmers' organization which it can not carry through satisfactorily and completely. We have had a little experience in this work at our station, and I consider it the most useful work the station has done, and not devoid of distinct and permanent scientific value. Above all, it has been of use to the farmers, and the value of any station is in the usefulness of its work to the everyday farmer."

Mr. F. E. Emery described the work done by the North Carolina Station in the line of coöperative experiments. While results of some permanent value had been obtained, they had not been considered of sufficient value to warrant the continuation of such experiments.

President J. Mills, of the Ontario Agricultural College, briefly explained the work in this line carried out under the supervision of his college. This had been principally in the line of variety tests of different crops. The experiments in almost every case were under the immediate management of graduates of the college, and had proved very successful and helpful to the farmers in the localities where they were made.

The subject of tuberculosis in cattle and the relation of the stations thereto was presented by the same section in general session, and caused a lively discussion, which was led by Director W. A. Henry, of Wisconsin, but was participated in very generally by members of the Association. It was shown that this disease is very widespread; that tuberculin has proved generally satisfactory as a diagnostic agent; and that many of the stations are giving attention to the subject either by experimenting with diseased animals, by endeavoring to provide protection to consumers of dairy products in the enactment of wise sanitary laws, or by teaching proper methods of sterilizing milk. The following resolution, bearing on this subject, introduced by Prof. W. M. Hays, of Minnesota, was adopted by the Association:

Resolved, That this Association recognizes the importance of controlling and preventing bovine tuberculosis, and that it is the sense of this body that officers of the various stations should use all legitimate means to increase and perfect provisions for further study and experiment in connection with this subject.

The discussion of the subject of the office of the station bulletin presented by the same section was led by President H. H. Goodell, of

Massachusetts, and Director M. A. Scovell, of Kentucky. President Goodell pointed out that "there should be two sets of bulletins; the one stripped of all scientific garb, setting forth in plain, unvarnished language such facts as have been ascertained, and addressed to the laity at large; and the other, in limited edition, addressed only to the scientific worker and putting on record the processes by which results have been secured."

Prof. Scovell referred to the need of carefully explaining terms used in reporting results of investigations in bulletins intended for popular distribution.

Prof. Hays explained to the Association the character of the card index of agriculture on which he has been engaged for some time, and which follows the same general plan as that adopted for the card index of this Office; and suggested the desirability of securing the coöperation of individual members of the Association and of the Office of Experiment Stations in this work. By action of the convention this matter was referred to a committee, consisting of Messrs. W. M. Hays, H. H. Wing, and C. S. Plumb, for consideration and report at the next annual convention.

The question of military equipment of land-grant colleges was discussed both in the section on college work, to which it was referred, and in general session. The following resolutions, reported by the section on college work, were approved by the Association:

Resolved, That it is the sense of this Association that the executive committee should continue its efforts to secure an appropriation for the purpose of furnishing, under restrictions, students in our land-grant colleges with uniforms and such other equipment as may be necessary for more complete instruction in military science and tactics.

Resolved, That the section on college work recommends to the general session that a committee of five be appointed to confer with the War Department relative to the military work in land-grant colleges.

Resolved, That the executive committee be instructed to secure legislation which shall require one officer of the Army to be detailed to each college receiving the benefits of either or both of the so-called Morrill acts which shall request it.

The committee appointed by the chair in conformity with these resolutions consisted of Messrs. H. E. Alvord, A. Q. Holladay, H. H. Goodell, N. D. Fratt, and R. W. Silvester.

The proposed section on station work effected a temporary organization, but it was decided by the convention to be inexpedient to make the section permanent.

It was decided to test the sense of the Association as to choice of the next place of meeting, and considerable friendly rivalry for this honor was developed. After the claims of a number of places had been duly presented a vote was taken, and it was found that sentiment was strongly in favor of Denver, Colorado.

After voting thanks for courtesies received and passing resolutions referring unfinished business to the executive committee for action at

its discretion, instructing this committee to obtain a cast and receive subscriptions for the bust of Senator Morrill,[1] and providing for the editing of the proceedings of the convention, one of the most earnest, interesting, and profitable conventions the Association has ever held adjourned.

The officers of the Association for the ensuing year are as follows: President, H. E. Alvord, of Oklahoma; vice-presidents, A. A. Johnson of Wyoming, A. Q. Holladay of North Carolina, T. B. Comstock of New Mexico, E. B. Craighead of South Carolina, and O. Clute of Florida; secretary and treasurer, J. H. Washburn, of Rhode Island; bibliographer, S. W. Johnson, of Connecticut; executive committee, the president, secretary and treasurer, and junior ex-president (S. D. Lee) *ex officio*, H. C. White of Georgia, M. A. Scovell of Kentucky, and H. P. Armsby of Pennsylvania.

Section on college work.—Chairman, A. W. Harris, of Maine; vice-chairman, J. H. Connell, of Texas; secretary, H. H. Wing, of New York.

Section on agriculture and chemistry.—Chairman, E. B. Voorhees, of New Jersey; vice-chairman, A. E. Blount, of New Mexico; secretary, C. C. Georgeson, of Kansas.

Section on botany and horticulture.—Chairman, S. M. Tracy, of Mississippi; vice-chairman, C. S. Crandall, of Colorado; secretary, W. R. Lazenby, of Ohio.

Section on entomology.—Chairman, C. P. Gillette, of Colorado; secretary, J. M. Aldrich, of Idaho.

Section on mechanic arts.—Chairman, J. K. Patterson, of Kentucky; secretary, F. P. Anderson, of Kentucky.

MEETINGS OF THE SECTIONS.

In the section on agriculture and chemistry Prof. H. H. Wing, of New York, opened the discussion on the scope of the short courses in agricultural colleges. This he considered largely a matter depending on who class of students in attendance. At Cornell University the best class of students in the short course were those from 18 to 25 years old, who were already fairly well trained in the manual work of the farm. With such students instruction should be directed largely toward inspiring them with a thirst for more complete information and inducing them to enter the regular college course. A less desirable class of students consisted of boys not familiar with farm life or with the best methods of farming. For these instruction by rules is necessary to a considerable extent. A short course of 12 weeks should not cover the whole ground of agriculture. The student should be made to realize how little he really knows at the completion of the short course.

[1] The price of the bust is at present $50. This will probably be reduced to $40 or $45 if the number of subscriptions is sufficiently large.

Prof. J. L. Hills, of Vermont, considered the scope of the short course a matter to be determined by local conditions. He believed there was a danger that the short course would divert young men from the regular 4 years' course. The ideal short course he considered to be one made up of studies taken out of the curriculum of the long course. In Vermont the only successful short course had been that in dairying.

Prof. C. S. Plumb, of Indiana, stated that at Purdue University all of the dairy instruction had been cut out from the regular course of 4 years and put into a special course. At this institution there are 5 lines of agricultural instruction from which the student may choose.

Prof. Hunt, of Ohio, believed that the short course should be concerned with a special subject. At the Ohio University the short course in agriculture occupies 2 years. The first year of this course contains no technical industrial study unless agricultural chemistry should be so considered, and the studies of this year prepare the student, with unimportant exceptions, for entrance to the freshman class in the 4 years' course. In the second year of the special course the student gets a considerable portion of the technical industrial studies of the regular 4 years' course.

Prof. Hays, of Minnesota, emphasized the need of special courses as a means of attracting students, and mentioned as examples the popularity of instruction in the slaughtering of animals at the Minnesota School of Agriculture and of the agricultural course for girls at the same institution.

Another subject on the programme was coöperation between the experiment stations, but this was widened to include coöperative field experiments by farmers. Mr. Woods, who opened the discussion, considered coöperative field experiments with farmers as of value chiefly from an educational point of view and not as furnishing safe data for scientific deductions.

Prof. Morrow, of Illinois, spoke of the advantage of stations consulting each other as to minor details of parallel experiments, in order that the results of their work might be comparable.

Director Smith, of Michigan, spoke of the advisability of station workers everywhere being supplied with diagrams of station farms on which experiments were conducted and with data as to the character of the soil, amount of rainfall, etc.

Dr. Frear spoke of the need of coöperation among stations in investigations to determine the effect of climate on plants. Mr. Mills, of Ontario, explained how in his province satisfactory results had been secured in coöperative experiments with about 2,000 farmers, most of them ex-students of the agricultural college.

Director Henry, of Wisconsin, believed that sooner or later the stations would be driven to a certain amount of coöperation by affinity of interest. It was urged by others that coöperative experiments in feeding animals were impracticable.

A motion introduced by C. D. Woods, of Connecticut, that a request be made that one session of the convention in 1895 be devoted to the discussion of methods of feeding in experiments with dairy animals, was carried.

In the section on college work President W. H. Scott, of Ohio, read a paper on faculty meetings. He especially emphasized the necessity of meetings for conference as well as for business purposes, and advocated intrusting to committees or subfaculties a large amount of the business sometimes transacted in faculty meetings. Meetings for conference were desirable because by these each professor keeps informed of the work of other departments, each receives a stimulus to do the best work in his own specialty, and a feeling of unity throughout all the departments of the college or university is engendered. Such meetings might be held in the evening, and occasional papers by members of the faculty would constitute a valuable feature.

Other subjects discussed by this section were: Standards of admission for agricultural colleges, methods of teaching agriculture, the establishment of an advisory bureau for the agricultural colleges in connection with one of the departments at Washington, and the relations of the land-grant colleges to the War Department.

In the section on mechanic arts the following papers were presented: "Shop course—its relation to the mechanical engineer," by L. E. Reber, of Pennsylvania; "Belt fastenings," by W. Flint, of Maine; "Some of the problems of manual training in our technical schools," by J. R. McColl, of Tennessee; "Shop courses for mechanical-engineering students," by J. J. Wilmore, of Alabama; and "What mechanical instruction shall we give the students in our agricultural colleges?" by W. C. Drake, of Rhode Island. The latter paper outlined a course of mechanical instruction for agricultural students, the outfit required, expense of outfit and of materials used by students, etc. This paper was also read at a general session of the Association.

At the meeting of the section on entomology Prof. Osborn spoke on "Entomological work of experiment stations." He pointed out the necessity of employing the proper means for treating insect injuries after the life history and remedies had been worked out, and urged that the farmers be instructed and interested in the proper remedial treatment, as far as possible. In carrying out this end personal letters to individuals were especially valuable. Coöperation among entomologists and mutual assistance was recommended, particularly in the testing of commercial insecticides, to determine the real value of the remedies in various sections of the country, and to distribute the responsibility of pronouncing upon their value.

In the ensuing discussion Prof. Bruner stated that he also had found personal letters frequently better than bulletins, and when replying to inquiries in regard to important pests frequently made several mimeograph copies of the answer, and sent them to other correspondents.

The value of institute and grange work, as interesting farmers in entomological matters and arousing their enthusiasm to combat insect attack, was discussed by Profs. Osborn, Bruner, and Beckwith. Prof. Bruner stated that he had given a large number of institute lectures the past summer, employing charts, drawings, and mounted specimens. He also each year furnished a report on the more prominent injurious insects of the season to the State Horticultural Society, to be printed in its annual report. In the case of important insect attacks, letters or articles on the subject were distributed free to several newspaper unions, whence they were printed and appeared in the patent insides of numerous newspapers throughout the State. A few illustrations caught the eyes of the readers, and so helped to attract attention to the matter contained. Prof. Osborn said that much the same plan—that of issuing press reports—had been followed this year in Iowa.

A paper by Prof. H. Garman, of Kentucky, on "The use of arsenites on tobacco," was read by the acting secretary. The growing practice of spraying tobacco with arsenites as treatment against the tobacco worm, and the popular belief that the crop is rendered dangerously poisonous thereby, led to investigations on the subject and experiments with spraying and analyzing tobacco. It was found that many tobacco growers had been for years quietly spraying their fields with Paris green for the destruction of the worms, and so doing away with the expense of hand "worming," but the proportion of arsenite and water employed varied greatly. Tobacco on the station grounds was sprayed twice with Paris green, 1 lb. to 160 gal. of water, the second spraying being 1 month before it was cut, dried, and analyzed. It was estimatod that each plant had received 3.96 grains of Paris green, and the analysis showed an average of 0.08 grain of arsenious oxid to each plant—an amount considered insufficient to produce any deleterious effects. As a result of the investigations a careful spraying of tobacco is not considered dangerous, 1 lb. of Paris green to 160 gal. of water being used and not more than three applications being made, the last spraying coming before the time of topping.

Prof. Osborn then read a paper on "Special insect attacks of 1894 in Iowa." The drought of the season rendered vegetation particularly susceptible to insect injury. The chinch bug was particularly damaging, and especially where winter wheat and rye had sheltered them during the winter and spring, they then going into spring wheat. The chief remedy employed was trenching. The results from the white fungus disease were not very favorable, owing to the drought. One hundred and sixty-four lots of infected bugs were sent out to farmers and 58 answers were received, 32 reporting more or less success. Only about 10 per cent of the field experiments were satisfactorily successful. The squash bug and onion thrips were destructive in some sections, and the melon louse diminished the yield of cucumbers, especially in the large fields near some of the pickle factories. The box-elder bug

is becoming quite numerous in the State, especially in the western half, where it is perhaps the most common insect.

In a discussion of the paper, speaking of the white fungus disease, Prof. Bruner stated that, although in dry seasons it was slow in destroying the bugs, it had been proved an indisputable fact that under favorable moist conditions it was a very effective aid in their destruction. The action of the disease was discussed, and the joint employment of agricultural methods was also urged. The hibernation of the chinch bugs was spoken of, and Prof. Osborn stated that he had found them wintering in bunch grasses, osage hedges, under the bark of trees, and in straw stacks, whence they emerged on warm days in winter to bask in the sunshine. Prof. Bruner said that the box-elder bug is becoming very abundant in Nebraska, where it attacks other plants, and frequently gets into greenhouses.

A paper on "The economic value of parasitism," by Prof. F. M. Webster, of Ohio, was read by the acting secretary. The writer maintained that only in very rare cases do the parasites fail to control an undue increase of injurious insects. The parasites increase with their hosts, although a little later, and thus maintain the balance. In support of the argument instances were given of devastations of the wheat midge being checked by *Coccinellidæ* and *Telephoridæ*, of *Mytilaspis pinifoliæ* and *Pulvinaria innumerabilis* by *Chilocorus bivulneris*, the grain aphis by its hymenopterous parasites, and the clover-leaf weevil (*Phytonomus punctatus*) by the fungus disease *Entomophthora sphærosperma*. It was urged that the assistance of the parasites should be recognized by entomologists and such remedial treatment employed as would not interfere with their action.

In the section on horticulture and botany the first paper was by Prof. H. N. Starnes, of Georgia, on "The proper position of hybrids in the classification of American grapes." A classification is proposed, dividing all sorts of grapes into 7 series or species, and all native subspecies are to be considered as varieties, the mother plant determining the series of the hybrid. The vineyard in charge of the author is arranged according to this classification. Prof. Lazenby suggested that similar investigations should be carried on in respect to the classification of hybrids among plums and other fruits. Prof. Burrill suggested that more of botany and the methods of botanists should be used by horticulturists in their description of varieties.

Prof. E. S. Goff's paper on "Plant breeding at experiment stations" was read by the secretary. The author made a strong plea for the origination of new varieties at the experiment stations, and stated that it was his conviction that important results must follow from plant breeding. The author's opinions were heartily concurred in by the section. Prof. Tracy suggested that selection was equally as important as crossing in the securing of new varieties, and he thought that variation as influenced by environment will determine the varieties desirable for

different regions. Prof. Lazenby thought it necessary to have an ideal in view toward which the horticulturist should strive, as does the stock breeder, in improving varieties.

Prof. W. J. Green, of Ohio, read two papers, (1) "The position of greenhouse benches for experiment work," and (2) "The construction of greenhouse benches for subirrigation." The author states that side benches are objectionable, and he advocated the division of the greenhouse space so as to have 2 benches with an alley 30 in. wide between them in the middle of the house and a narrow one running along each side wall. The 2-bench plan has proved, in the author's estimation, vastly superior to 3 benches for plat work, and probably will be found advantageous in commercial work, as it utilizes all available space. For subirrigation hexagonal tile are laid upon the bottom of the bench and the water runs out at the joints, wetting the soil uniformly. If the water runs out of the lower end of the tile too freely, due to too great an incline in the bench, it may be checked by using small sheets of tin placed between the joints of the tile at any point where more water is desired in the bed.

Prof. B. D. Halsted read a paper on "Field experiments with fungicides." He gave in detail his methods of arranging plats and the various strengths of fungicides used. The experiments were conducted on cabbage, tomatoes, potatoes, and beans. The author reported in detail on the results obtained during the present year with beans. Two crops were grown, the second one being reported upon. Three strengths of Bordeaux mixture were used and the plants sprayed 8 times. In other plats they were sprayed 8 times with ammoniacal copper carbonate solution. His conclusions were: (1) Soaking seed has no effect upon the prevention of spot disease. (2) Spraying all plants is advantageous in ratio of more than 10 : 1. (3) Bordeaux mixture is better than ammoniacal copper carbonate solution in ratio of 4 : 1. (4) Spraying dwarfed plants one third where the full strength was used, one sixth where one half strength was used, and one seventh where one fourth strength was used. Where the full strength of the fungicide was used the total weight of stems and roots was decreased one half.

Prof. Halsted also reported on some field experiments with beets, using Bordeaux mixture and ammoniacal copper carbonate in various strengths and spraying the plants 8 times. Ammoniacal copper carbonate is not a successful fungicide in this connection. Bordeaux mixture increased the weight of beets harvested about one fourth over the check plats.

Prof. L. C. Corbett's paper on "The determination of sex in *Shepherdia argentia*" was read by the secretary. The diœcious quality of the plants was pointed out and it was shown that the buds vary greatly in the two forms of plants. Ordinarily the plants were sold regardless of sex hence the frequent complaint of their infertility. A little care in recognizing the bud characters would prevent this trouble.

A paper by Prof. L. H. Pammel on "Root rot of ruta-bagas" was read by the secretary. A fatal root rot of ruta-bagas was found to be due to a new species of bacillus, described as *Bacillus campestris.* It was first noticed in 1892, and in 1893 destroyed about 50 per cent. of the crop. It also attacks yellow turnips, beets, and sugar beets. The attack ordinarily begins in the crown and may be recognized by a very peculiar odor, the fibrovascular bundles become black, and the surrounding tissues greatly affected. The disease is abundant in wet weather and almost entirely disappears during drought. The soil seems to have no influence upon it. The author isolated and made cultures of the bacillus. Inoculations made upon ruta-bagas caused the disease to appear in a few days. Prof. Mell reported a similar disease in Alabama, which may prove the same.

Prof. H. L. Bolley's paper on "The effect of change of soil upon the growth of wheat" was read by Prof. Lazenby. The author mentioned the practice of exchanging seed wheat from locality to locality and its effect on the quality of the grain. Samples of wheat were grown from various parts of the State, representing all kinds of soil. The conclusions arrived at from the experiments were (1) that the grain or fruit of wheat is much less subject to variation than its vegetative part; (2) that true varieties under like soil and climatic conditions will approximate a like product without reference to the parent soil; and (3) the change of seed wheat because of supposed advantages to be attained by change of soil is based upon a fallacious supposition.

Two papers by Prof. Pammel were read by title, namely: (1) "On the distribution of some weeds in the United States, especially *Iva xanthifolia*, *Lactuca scariola*, *Solanum rostratum*, and *S. carolinense*;" and (2) "Notes on the diseases of plants at Ames, Iowa, in 1894."

Prof. C. B. Waldron's paper on "A new Macrosporium disease of squashes" was read by the secretary. The disease attacks the young fruit at the blossom end and is not found on any other part of the plants. Cultures and inoculations of the fungus have been made. The fungus has been determined by J. B. Ellis, who named it *Macrosporium microsporium*.

Prof. F. W. Rane, of West Virginia, contributed some remarks on subirrigation out-of-doors. Ordinary tile were laid in rows above ground and celery planted on either side. At first this gave surface irrigation, but as the celery was hilled up the tile became covered, virtually giving a method of subirrigation. The method is described as simple, practical, and inexpensive.

RECENT WORK IN AGRICULTURAL SCIENCE.

CHEMISTRY.

Determination of nitrogen in nitrates (*Kentucky Sta. Rpt. 1891, pp. 17–19*).—In the determination of nitrogen in nitrates by the Kjeldahl method the effect was tried of using potassium iodid, hydrogen sulphid, and mercuric hyposulphite in place of the reducing agents commonly used. The sample tested, a mixture of sodium and potassium nitrates, contained theoretically 14.72 per cent of nitrogen. The results with hydrogen sulphid "approach nearest of all to the theoretical and are a trifle higher than was obtained by the use either of zinc sulphid or hyposulphite of mercury." The hydrogen sulphid was conducted into the digestion flask after the addition of salicylic acid for about 10 minutes, until a copious deposit of sulphur had been formed.

The determination of nitric acid in alkaline nitrates, E. BREUTEL (*Ber. Oesterr. Ges., 1894, p. 218; abs. in Ztschr. angew. Chem., 1894, No. 18, p. 568*).—One gram of the nitrate dried at 120 to 130° C. is weighed out into a crucible, mixed with 3 to 4 times its weight of fresh ignited tungstic acid, and covered with the same substance to a depth of a few millimeters. The whole is weighed again and heated, gently at first, but at a gradually increasing temperature as the decomposition proceeds, maintaining the temperature below red heat until no further fumes of nitric acid pass off, which usually requires from 15 to 20 minutes. The loss of weight gives the amount of nitric acid. Chlorid of sodium and sulphate of sodium are not decomposed in this process.

The determination of phosphoric acid by the citrate method, F. GLASER (*Ztschr. angew. Chem., 1894, No. 18, pp. 543–545*).—Determinations of phosphoric acid in sodium and potassium phosphate solutions by the citrate method, using amounts of magnesia mixture varying from 25 to 100 cc. are reported, together with the results of check analyses by the molybdate method.

With 25 cc. of magnesia mixture the results were much too low, the full percentage of phosphoric acid not being obtained until 60 cc. of the solution was added. It appeared that the greater portion of this error was due to the volatilization of phosphoric acid in igniting the precipitates, as pointed out by Neubauer,[1] but a part was undoubtedly

[1] Ztschr. anorgan. Chem., 2 (1892), p. 45 (E. S. R., 4, p. 584).

due to incomplete precipitation of the phosphoric acid with the smaller amounts of magnesia mixture.

It is believed that losses from the use of only 25 cc. of magnesia mixture in ordinary fertilizer analysis are comparatively insignificant, especially when phosphates rich in phosphoric acid are examined and the precipitate is ignited in a Gooch crucible for only a short time.

Further experiments are reported which show that in order to get uniform results when precipitating with 25 cc. of magnesia mixture the solution should be allowed to stand a few hours, with frequent vigorous stirring.

A method for the quantitative determination of water-soluble phosphoric acid in superphosphates, W. KALMANN and K. MEISSELS (*Chem. Ztg., 18 (1894), No. 16, Repert., p. 180*).—The method proposed is based upon the difference in the behavior of solutions of phosphates toward methyl orange and phenolpthalein as indicators. Titration with the former indicates one third of the acid present, and with the latter the remaining two thirds. The method is carried out as follows: 20 gm. of superphosphate is dissolved in 1 liter of water; to 100 cc. of the filtrate methyl orange is added, and the solution neutralized with half normal alkali. The same amount is titrated with half normal alkali, using phenolpthalein as an indicator. The amount of alkali required is designated *a*. Another 100 cc. of the filtrate is measured into a 250 cc. flask, a large excess of half normal alkali added, and the flask filled to the mark. Aliquots (100 cc.) of this solution are titrated with half normal standard acid, using phenolpthalein and methyl orange as before. The amount of standard alkali required multiplied by 2.5 represents the amount required by 100 cc. of the original solution, and is designated *b;* the mean of *a* and *b* multiplied by 0.0355 gives the amount of phosphoric acid (P_2O_5) in 100 cc. of the original solution (equal to 2 gm. of substance).

On titration with Fehling's solution, and obtaining clear filtrates, H. KRÁL (*Pharm. Central Halle, 35, p. 411; abs. in Chem. Centbl., 1894, II, No. 9, p. 448*).—The end of the reaction is recognized by acidulating the filtrate from the titration and adding a little very finely powdered potassium ferrocyanid. The smallest trace of copper is shown by a red zone. The reaction with the powder is more sensitive than with a concentrated solution of the potassium ferrocyanid. Before filtering the author adds a little silica guhr (*kielselguhr*) to the filter, which prevents the slightest trace of cuprous oxid from passing the filter. The use of silica guhr is also recommended in preparing cloudy urine for polarization in sugar determination.

The determination of lecithin in plants, B. VON BITTE (*Ztschr. physiol. Chem., 19, No. 4 and 5, pp. 488–498*).—From his studies on the determination of lecithin the author concludes that only a part of the lecithin is dissolved out when the material is extracted with ether and then twice with alcohol, an hour each time. To determine the lecithin

quantitatively the extraction with ether must be followed by at least 30 extractions with ethyl alcohol or 20 with methyl alcohol, each extraction lasting 8 to 10 minutes, but never longer than 15 minutes.

The determination of fat in milk by centrifugal means, and a comparison of the Babcock and Gerber methods, J. ZEHENTER (*Programm Oberrealschule in Innsbruck für 1893–'94; abs. in Chem. Centbl., 1894, II, No. 9, p. 458; and in Chem. Ztg., 18 (1894), No. 66, Repert., p. 198*).—A historical review is given of the development of centrifugal methods for determining fat in milk, description of various centrifugal methods, and a comparison of the Babcock and Gerber methods with the gravimetric and Soxhlet's aërometric methods. In Gerber's "acid butyrometric" method[1] the milk is mixed with a quantity of amyl alcohol in a long-necked graduated tube, an acid mixture not described is added, and the tube is whirled in a warm centrifuge.

In this comparison 3 out of 34 tests with the Babcock method differed from the gravimetric results by more than 0.1 per cent, 6 by more than 0.05 per cent, and the rest by less than 0.005 per cent; hence 73.5 per cent of the determinations was within 0.05 per cent. With Gerber's method 63 per cent of the results agreed within 0.05 per cent with the gravimetric results, and the largest variation with whole milk was 0.11 per cent.

The author finds little to choose between the two methods in accuracy or rapidity. At present the Babcock machine for an equal number of tubes is said to cost more than the Gerber, although the single determinations with the latter cost nearly twice as much as with the former, owing to the expensiveness of Gerber's acid mixture. It is said, however, that Gerber proposes to substitute sulphuric acid of 1.82 to 1.825 sp. gr. for his acid mixture and use larger tubes, which will reduce the cost of making the test.

The recognition of vegetable oils in butter, SCHÖNVOGEL (*Chem. Ztg., 18 (1894), No. 75, p. 1449*).—In examining artificial butter in the Caucasus, said to be made from a mixture of animal and vegetable fats, the author has found the reactions with concentrated borax solution useful in distinguishing vegetable oils, and caustic soda solution for distinguishing butter from pure margarin.

The determination of volatile and insoluble fatty acids in butter fat, W. H. BEAL (*Jour. Amer. Chem. Soc., 16 (1894), No. 10, pp. 673–676*).—For determining the volatile acids approximately 2.5 gm. of the pure fat is saponified with 2 cc. of a solution prepared by dissolving 50 gm. of potassium hydroxid (free from carbonates) in 100 cc. of water and 5 cc. of strong (95 per cent) alcohol, heating with a reflex condenser on a water or steam bath, and removing the last traces of alcohol by means of a filter pump.

"The soap thus obtained is dissolved in 30 cc. of warm water and decomposed with 20 cc. of a 20 per cent solution of orthophosphoric acid. The volatile acids are

[1] Chem. Ztg., 16 (1894), pp. 1839, 1840; Chem. Centbl., 1893, I, p. 233, and II, p. 665.

expelled from the flask by means of a current of steam [using a special form of apparatus, which is illustrated and described]. The operation is usually complete when 500 cc. have passed over, although as an extra precaution 50 cc. more should be distilled over and titrated separately. For titration, decinormal soda solution and phenolphthalein are used."

In determining the insoluble acids the apparatus is rinsed back into the distilling flask with hot water, the residue extracted with hot water, and the solution when cold passed through the same filter used for the distillate. This operation is repeated until the washings contain no trace of phosphoric acid, when the filter is exhausted with hot, strong alcohol and the extract added to the insoluble acids. The alcohol is driven off on the water bath and the fatty acids dried at 100° C. in the air bath until they begin to gain weight. "The expulsion of the volatile acids by means of a current of steam proved to be a decided improvement over direct boiling of the solution containing the fatty acids."

Contribution to the examination of fats and fatty acids, W. THÖRNER (*Chem. Ztg., 18 (1894), No. 61, pp. 1154, 1155*).—A reference table is given showing the values for the fatty acids, specific gravity, index of refraction, polarization, melting point, point of crystallization, saponification equivalent, and iodin numbers of some 20 different animal and vegetable oils. An apparatus is illustrated for maintaining the fat at the desired temperature while taking specific gravity with a Westphal balance.

Report of chemical division of Kentucky Station, 1893, A. M. PETER (*Kentucky Sta. Rpt. 1893, pp. 10–15*).—A trial of Sweetser's method for determining fat in butter; analyses of soils, hickory-wood ashes, nitrate of potash, phosphatic limestone, Oriental fertilizer and insect destroyer, and malt sprouts with reference to fertilizing ingredients; and a note on the presence of arsenic in sprayed tobacco (p. 315). Sweetser's method (E. S. R., 6, p. 108) was compared with the official method on 7 samples of butter. On an average it gave results about 1 per cent higher than the official method.

"The results obtained are not satisfactory, though of course the test of the method was not by any means as thorough as could be desired. They seem to indicate that the method would be improved by drying the butter before solution and decanting the solution from the salt before making up, as suggested by Mr. Sweetser."

Butyric acid fermentation, A. BÉCHAMP (*Bul. Soc. Chim. Paris, 11 (1894), No. 12, p. 531*).—The author states that the formula usually given for the production of butyric acid from lactic acid by fermentation, *e. g.*, $2C_3H_6O_3 = C_4H_8O_2 + 2CO_2 + 4H$, is incorrect. The fermentation of calcium lactate is said to give invariably some alcohol, more or less acetic acid, butyric acid, and usually propionic, caproic, and caprylic acids.

A contribution to the knowledge of vegetable albuminoids, W. PALLADIN (*Ztschr. Biol., 31, No. 2, pp. 191–202*).—Vitellin was prepared from the seeds of yellow lupine and studied. The author classes it as an albumose with some characteristics of the globulins, and places it between the globulins and the albumoses. Vegetable albuminoids are said to be accompanied by an unknown nitrogenous substance. The author believes that the number of different albuminoids in plants is not as large as has been generally stated.

Pepton salts of egg albumen, C. PAUL (*Ber. deut. chem. Ges., 27, pp. 1827–1851; abs. in Chem. Centbl., 1894, II, No. 7, p. 329*).

Comparative studies on the decomposition of egg albumen by vibriones, A. W. GRIGORIEW (*Arch. Hyg., 21, No. 2, pp. 142–165*).

Piceïn, a glucosid in the leaves of Pinus picea, TANRET (*Compt. Rend., 119 (1894), p. 80*).

The generation of chlorin for laboratory purposes, F. A. GOOCH and D. A. KREIDER (*Amer. Jour. Sci., 48 (1894), Aug.; abs. in Chem. News, 70 (1894), No. 1818, p. 156*).

The generation of chlorin for laboratory purposes, W. H. PENDLEBURG (*Chem. News, 70 (1894), No. 1819, pp. 172, 173*).—Remarks upon the above paper.

A new hydrogen sulphid apparatus, H. BREARLEY (*Chem. News, 70 (1894), No. 1818, p. 160, fig. 1*).

Convenient burette clamp, C. QUINAN (*Jour. Amer. Chem. Soc., 16 (1894), No. 10, p. 719, fig. 1*).

A device for the adjustment of a balance, F. T. GREEN (*Jour. Amer. Chem. Soc., 16 (1894), No. 10, p. 699, figs. 3*).

A simple viscosimeter, M. WENDRINES (*Ztschr. angew. Chem., 1894, No. 18, pp. 545–547, fig. 1*).

Analysis of nitrate of soda, L. GRANDEAU, D. CRISPO, and F. JEAN (*Jour. Agr. Prat., 58 (1894), No. 35, pp. 303–307*).—The difference and Schlösing-Grandeau methods are discussed, with the general conclusion that the latter only is in all cases reliable.

Comparison of Kjeldahl-Wilfarth and Stock methods for determining nitrogen, E. CAVAZZANI and A. CECCONI (*Ann. Chim. e Farmakol., 20 (1894), p. 87; abs. in Analyst, 19 (1894), Oct., p. 224*).—Comparative analyses by the authors of blood, milk, and urine showed that Stock's method (E. S. R., 4, p. 86) was considerably more rapid than the Kjeldahl, but gave lower results. The difference was least with milk, amounting with blood and urine to 8 to 9 per cent. They conclude that Stock's method is only applicable where rapidity is more important than extreme accuracy.

Control of the requisites for polarization of cane sugar, S. NEUMANN (*Oesterr. ungar. Ztschr. Zuckerind. und Landw., 1894, No. 3; abs. in Chem. Centbl., 1894, II, No. 9, p. 455*).

The estimation of glucose in sugar juice, H. WINTER (*West Java Sugar Sta. Contr. 1, pp. 1–15*).

A gravimeter for sugar analysis, W. K. GIRD (*Jour. Amer. Chem. Soc., 16 (1894), No. 10, pp. 677, 678, fig. 1*).

Gravimetric determination of reducing sugars with Fehling's solution, C. KILLING (*Ztschr. angew. Chem., 1894, pp. 431–433; abs. Chem. Centbl., 1894, II, No. 9, p. 454*).

Notes on the estimation of crude fiber in sugar cane, J. L. BEESON (*Sugar Cane, 1894, pp. 530–534*).

Recent work on the sugars, B. B. ROSS (*Jour. Amer. Chem. Soc., 16 (1894), No. 10, pp. 670–673*).—Second paper of this résumé.

Notes on water analysis (cont.), C. A. SEYLER (*Chem. News, 70 (1894), No. 1817, pp. 140, 141; No. 1818, pp. 151, 152*).

Critical study of the methods of determining carbonic acid in drinking and mineral waters, with especial reference to distinguishing between those containing free or half-bound carbonic acid from those containing carbonic acid bound to monocarbonates, together with contributions on the formation of carbonates in water, C. KIPPENBERGER (*Forsch. ü. Lebensmtl., 1, pp. 263–275, 332–342; abs. in Chem. Centbl., 1894, II, No. 9, p. 451, and No. 10, p. 495*).

Analysis of butter and margarin, C. VIOLETTE (*Rev. Internat. Falsif., 8 (1894), No. 1, pp. 8–11, fig. 1*).—A review of methods and a description of an improved method for determining volatile acids proposed by the author.

The microscopic examination of butter with polarized light and the use of the Zeiss refractometer, C. BESANO (*Staz. Sper. Agr. Ital., 26 (1894), No. 6, pp. 601–614*).

The oleorefractometer in butter analysis, C. A. LOBRY DE BRUYN (*Chem. Ztg., 18 (1894), No. 73, pp. 1400, 1401*).

Method for the determination of the freezing point of fatty acids, F. WOLFBAUER (*Jour. Amer. Chem. Soc., 16 (1894), No. 10, pp. 665–670*).

On the Valenta acetic acid test, W. CHATTAWAY, T. H. PEARMAIN, and C. G. MOOR (*Analyst, 1894, July, pp. 147–150*).

Turbidity temperature of oils and fats with glacial acetic acids, E. W. T. JONES (*Analyst, 1894, July, pp. 151–155*).

Determination of alkalinity in cane sugars, M. NEVOLE (*Oesterr. ungar. Ztschr. Zuckerind. und Landw., 1894, No. 3; abs. in Chem. Centbl., 1894, II, No. 9, p. 456*).

The ash content of cane juice, J. H. KRAMERS (*East Java Expt. Sta. Contr. 49, pp. 76–105*).

Investigations on cane wax, H. C. P. GEERLIGS (*Repr. from Arch. Java Suikerind., 1893, p. 263*).

The estimation of sugar in cane, H. WINTER (*West Java Sugar Sta. Contr. 1, pp. 15–20*).

Causes of disagreement in the results of analyses effected by different chemists, DUDLEY (*Rev. Univ. Mines et Metallur., 26 (1894), No. 3; abs. in Chem. News, 70 (1894), No. 1820, p. 186*).

Report of chemical division of Kentucky Station, 1891 (*Kentucky Sta. Rpt. 1891, pp. 9–40*).—Analyses are given of butter (p. 337), sorghum cane, phosphatic limestone, ash of corn (p. 288), and limonite; and a report on the analyses of samples of sugar, molasses, confections, and honey made for the Division of Chemistry of this Department and published in part VI of Bulletin No. 13 of that division.

Report of chemist of Kentucky Station, 1892 (*Kentucky Sta. Rpt. 1892, pp. 9–20*).—Analyses are given of butter (p. 337), spurry, Hungarian grass cut for hay, cheat, serradella, sweet clover (*Melilotus alba*), clover hay, wheat bran, corn-and-cob meal, ground shelled oats, linseed meal, "ground mixed feed," cotton-seed hulls, sorghum-cane juices, marls, soils, tobacco stems, hickory-wood ashes, mud from river bottom, refuse from salt works, burnt marl, sawmill ashes, bituminous shale, ginseng roots, "par oïdium," or "black sulphur," and asphalt rock, and mention is made of examinations of the viscera of cattle for poisoning.

BOTANY.

Notes on maize, E. L. STURTEVANT (*Torrey Bul., 21 (1894), No. 8, pp. 319–343*).

Synopsis.—The author gives a list of botanical species and varieties; a report of experiments on germination, hardiness, and prolificacy; a sketch of the synonomy and history of the different species; early cultivation and distribution of maize, and relation of maize to its environment.

Contrary to the prevailing system of grouping all forms under the name *Zea mays*, the author divides them as follows: *Zea tunicata*, or pod corns, from which are derived *Zea everta*, pop corns; *Z. indurata*, flint corns; *Z. indentata*, dent corns; *Z. amylacea*, soft corns; *Z. saccharata*, sweet corns; and *Z. amyleasaccharata*, starchy, sweet corns. Each of these species has 3 varieties or subspecies: (1) kernel broader than long, (2) kernel broad as long, and (3) kernel longer than broad. It seems probable that greater climatic relations exist between these

subgroups than in the species. The short, broad grain seems best suited to a short season, while the others require a longer season.

Tabular information is given regarding the germination and comparative hardiness and prolificacy under different conditions of spacing and planting. The prolificacy is influenced by the distance of spacing. Most kinds of corn will germinate while in the milk or before the hardening of the grains has taken place. The more flinty the corn the earlier and more certain its germination.

The various species are described as follows:

"*Zea everta.*—The kernel split laterally shows the chit and corneous matter enveloping; in some cases a fine starchy line. The small size of the kernel and the property of 'popping' makes identification certain.

"*Zea indurata.*—The split kernel exhibits the chit, starchy matter, and a corneous matter enveloping. It can not be confounded with any other species except the pop, from which it is distinguished by the larger kernel and inability to 'pop.'

"*Zea indentata.*—The split kernel exposes the chit, corneous matter at the sides, the starchy matter extending to the summit.

"*Zea amylacea.*—The split kernel shows only the chit and starchy matter, corneous matter being entirely absent.

"*Zea saccharata.*—The kernel of this species has a semitransparent or translucent, horny appearance, and is more or less crinkled, wrinkled, or shriveled.

"*Zea amyleasaccharata.*—The external appearance of the kernel is that of a sweet, but examination shows that the lower half of the kernel is starchy, the upper half horny and translucent. These varieties had all a white cob, the kernels deeper than broad, or belong to subspecies 3.

"*Zea tunicata.*—In this species each kernel is inclosed in a pod or husk, and the ear thus formed itself inclosed in a husk."

In addition to the descriptions copious references to synonomy and history are given. The author thinks *Zea tunicata* probably the original form of maize; *Z. everta*, the pop corns, nearest the primitive form, and *Z. amylacea*, the soft corns, the most highly developed. Many instances are cited of reversion to podded forms among even the more common varieties of corn, tending to prove it the primitive form.

Numerous references are cited showing the antiquity and universality of cultivation of corn by the early inhabitants of both North and South America. The origin is placed either in Peru or in Mexico. The data are hardly sufficient to settle this question, but from the large number of varieties and the range of species in Peru the author inclines to that as the original habitat. The relation of maize to its environment has been but little studied. It is stated that corn will germinate at a temperature as low as 42 to 43° F. Corn from Mexico, represented as growing to the height of a man and maturing early, grew in New York to a height of 11 ft., and was just coming into bloom when killed by a frost in October. Moisture seems to develop height, aridity to dwarf. On the other hand, some varieties seem to remain dwarf under all observed conditions, and both the tallest growing and most dwarf forms are reported from hot, moist, tropical regions.

Investigations concerning the metabolism and respiration of potatoes and other germinating plants, E. ZIEGENBEIN (*Pringsheim's Jahrb. wiss. Bot., 25, No. 4, pp. 563–606; abs. in Forsch. Geb. agr. Phys., 17 (1894), No. 1 and 2, pp. 143–146*).—Analyses showed that by the exclusion of oxygen the decomposition of the albumen of the protoplasm takes place with as great rapidity as when exposed to the ordinary atmospheric conditions. The free nitrogen in the objects of experimentation was not exhausted even after subjecting portions of the plants to an atmosphere of hydrogen for 24 hours. The effect of light conditions on the metabolism and respiration of potato tubers was investigated at considerable length. The ordinary well-known conditions of sprouts grown in the light and in darkness is mentioned, and C. Kraus is quoted as advocating the theory that the limited growth in darkness of the first sprouts is due not to lack of light, but to an insufficient water supply. The author thinks it due wholly to the absence of light. In a moist atmosphere the dry matter content of the germinating tuber will be practically the same in the light or dark. In a dry atmosphere there will usually be more water found in the potato growing in the dark and a greater amount of starch in the sprouts.

Potatoes which have been growing in the light for a considerable time in either a dry or a moist atmosphere give off considerably more carbon dioxid when placed in the dark. It is probable that light induces some conditions more favorable to increased respiration than darkness. In this case the increase is explained as caused by the dissociation of the albuminoid molecules, due to the direct action of the light. The water and sugar content seem to vary according as the tubers are grown in the light or dark. The tuber sprouted in a moist atmosphere and kept in the dark contains more sugar than a similar one in the light. The diastase content does not vary in the same way, since there is practically no difference in the ferments present in each case. In a moist atmosphere light causes an increased respiration and consequently greater albuminoid metabolism. The total sugar content goes to regenerating the destroyed albuminoids, and whatever surplus remains is stored up as reserve material.

In investigating the relation of temperature to respiration it was found that for the normal respiration of the flower heads of *Taraxacum*, as well as of plantlets of wheat, lupines, and the flowers of syringa, the optimum temperature is about 40° C. For the sprouts of *Abies excelsa* and young plants of *Vicia faba* it was 35°, and for potatoes about 45°. The maximum for the young plants of wheat, lupine, and bean, the flower heads of *Taraxacum*, and sprouts of *Abies* is 45°; for syringa flowers 50°, and for the potato 55°. On the other hand, young wheat and lupine plants continue to respire at as low a temperature as —2° C.

If plants of *Vicia* or lupine, having established their respiration at 15 to 20°, be warmed up to 30° and again reduced as before, no difference will be noticed in their total respiration. If, however, the temper-

ature goes above 42 to 43.5°, the optimum for the lupine, the respiration will be somewhat less than before and the vitality of the plants also weakened.

On the formation of carbon dioxid and absorption of oxygen by detached leaves, BERTHELOT and G. ANDRÉ (*Ann. Chim. et Phys., ser. 7, 2 (1894), pp. 293–339*).—The authors have made a study of the changes taking place in detached leaves, whether due to chemical oxidation, to biological causes, or the action of bacteria on the leaves. These changes offer an evident connection between the gaseous exchanges of the air and the plant, which characterizes plant respiration, and by which the substance of the leaves is returned to the soil in binary compounds, as water and carbon dioxid, and the other principles constituting the soil. Three species of plants were selected for the experiments. Wheat, representing an annual plant, quickly drying and losing its vitality; *Sedum maximum*, as a perennial with very thick leaves, of great vitality and drying with difficulty in ordinary air; and the hazel nut, or filbert (*Corylus avellana*), as a ligneous plant whose leaves offer an entirely different structure from either of the preceding and which are capable of rapid drying. The elementary composition of each was determined before beginning, and in every set of experiments the conditions were made identical.

The experiments were divided into 2 groups: (1) those made at a temperature of 100 to 110° C., resulting in the immediate destruction of the vitality of the leaves and giving purely chemical results, and (2) those conducted at normal temperatures assisted by the action of the cells and their contents and exterior microörganisms.

In the first group are given the series of experiments which were conducted (1) in a current of hydrogen, the water and CO_2 collected; (2) the same in current of air; (3) leaves in water and the vessel containing them traversed with an air current; and (4) wet leaves placed in a vessel of oxygen and sealed. In the second group there were 2 series. The leaves of one series were dried over sulphuric acid under a bell jar and in the other they were kept in a humid, saturated atmosphere, and aided by the action of the organic materials of the leaves and various microörganisms.

The results of the experiments in all cases, whether the change was rapidly made at a high temperature or much slower at a normal one, show that there was a constant increase in the carbon dioxid formed and the oxygen taken in. This latter is shown in several cases by the increased quantity of water found in the final over the initial analysis of the leaves. The volume of CO_2 formed sometimes is 3 to 5 times the volume of the dry matter of the leaves or 2 or 3 times that of the green leaf. It was found that the amount by weight of CO_2 formed varied greatly with the experiment and the kind of plant used. The extremes of CO_2 given off were 0.27 to 41 per cent for the dry matter of

the leaves, or 0.29 to 23.5 per cent of the carbon contained in the leaf. The higher amount was given off in the second group of experiments.

Influence of town atmosphere on vegetation (*Abs. in Gard. Chron., 16 (1894), ser. 3, p. 344*).—Experiments were made on *Hydrangea hortensis* to ascertain the best kind of manure for this plant, and incidentally the effect of city atmosphere was very strikingly shown. Plants from the same nursery were grown under as nearly the same conditions of soil, manure, and attention as possible at Berlin, in a park surrounded by large buildings and near 2 railroad termini; at Lichterfelde, about 7 miles southwest of Berlin, in a region where only cottages, fields, and forests surround; and at Spindlersfeld, about 7 miles southeast of Berlin, where there are some large buildings and a few factories. Sixty plants were grown at each station. At Lichterfelde 365 shoots were grown, of which 287 produced flowers; at Spindlersfeld 334 shoots were grown, 242 producing flowers; at Berlin only 274 shoots were grown and only 152 produced flowers. The diameter of clusters at Spindlersfeld was from 24 to 33 cm., while at Berlin it was 9 to 12 cm.

Fixation of free nitrogen by algæ, P. KOSSOWITSCH (*Bot. Ztg., 1894, p. 97; abs. in Chem. Ztg., 18 (1894), No. 52, Repert., p. 161*).—The author shows that there is no assimilation of free nitrogen of the air in pure cultures of 2 algæ belonging to the genera *Cystococcus* and *Stichococcus*, when under suitable conditions for their growth. The experiment of various authors in which by contact of bacteria and algæ in the light the free nitrogen of the air was fixed, the author explains through the supposition that algæ are unable to fix free nitrogen but play a secondary part, the bacteria furnishing carbon dioxid which they form during the processes of assimilation in the light. In other cases, not pure cultures, through the presence of sugar the nitrogen fixation appeared to be greatly assisted. It appears that nitrogen fixation would be favored by the presence of algæ with jelly-like membranes, as *Nostoc*, and it is not unlikely that the slime membranes of bacteria offer an especially good nourishing medium through which fixation may take place.

List of medicinal plants of commercial value gathered in North Carolina, W. SIMPSON (*Amer. Jour. Pharm., 66 (1894), No. 10, pp. 486–490*).

Hanover fungus flora, C. WEHMER (*Jahresber. naturhist. Ges.. 1891–'93, pp. 2–90*).—List of species, with critical notes.

The Anonaceæ of British India (*Ann. Roy. Bot. Gard. Calcutta, 1893; abs. in Bot. Centbl., 59 (1894), No. 12, pp. 371, 372*).

Mauritius and other fiber plants (*Barbados Bot. Sta. Misc. Bul. 1*).—Compiled information regarding the Mauritius hemp, *Furcræa gigantea*, and sisal hemp, *Agave rigida sisiliana*.

Catalogue of the indigenous plants of Natal, J. M. WOOD (*Durban: 1894, p. 47*).—A preliminary list of the phanerogams and vascular cryptogams of Natal, including a few from Zululand. The list contains 828 genera and 2,607 species.

A companion for the Queensland student of plant life, F. M. BAILEY (*Ann. Rpt. Dept. Agr. Queensland, 1892–'93, p. 108*).—An elaborate glossary of botanical

terms, with an introductory chapter on systematic, structural, and physiological botany and an addendum of 7 of the larger orders of plants

Contributions to the flora of Queensland, F. M. BAILEY (*Ann. Rpt. Dept. Agr. Queensland, 1892–'93, p. 58, pls. 19*).—List of fresh-water algæ, with descriptions of new species.

Contributions to the flora of Queensland, F. M. BAILEY (*Ann. Rpt. Dept. Agr. Queensland, 1892–'93, pp. 59–69*).—List of phanerogams and vascular cryptogams, with descriptions of new species.

Investigations on the Nymphæaceæ, R. SCHUMANN (*Ber. deut. bot. Ges., 12 (1894), No. 7, pp. 173–178*).—Review of the work of Raciborski, which is compared with that of the author.

Anatomy of the wood of Albizzia molucanna, A. BURGERSTEIN (*Ber. deut. bot. Ges., 12 (1894), No. 7, pp. 170–172*).

Comparative anatomy of the Casuarineæ, with special reference to the Gnetaceæ and Cupuliferæ, L. A. BOODLE and W. C. WORSDELL (*Ann. Bot., 8 (1894), No. 31, pp. 231–264, pls. 2*).

The effect of strychnin solutions on the development of plants in different kinds of soils, R. OTTO (*Ztschr. Pflanzenkrank., 4 (1894), No. 4, pp. 210–213*).

The influence of climate, especially of rainfall, on the form of the fruit, J. R. JUNGER (*Bot. Centbl., 59 (1894), No. 3 and 4, pp. 65–74, tables 2*).

The influence of light on forcing the buds of red beech, L. JOST (*Ber. deut. bot. Ges., 12 (1894), No. 7, pp. 188–197*).

Concerning the bud development of deciduous trees, P. ALBERT (*Forstl. naturw. Ztschr., 3 (1894), No. 9, pp. 346–376; No. 10, pp. 393–419*).

Contribution to the study of the embryology of Betulaceæ, S. NAWASCHIN (*Ber. deut. bot. Ges., 12 (1894), No. 7, pp. 163–169*).

The penetration of living tissues by roots, G. J. PIERCE (*Bot. Ztg., 52 (1894), No. 8 and 9, pt. 1, pp. 169–174*).

Effect of submersion on roots (*Gard. Chron., 16 (1894), ser. 3, p. 255*).—The claim that roots submerged for any considerable time will die is refuted by the practice of submerging vines for 30 to 60 days to destroy the phylloxera. Müntz says that such roots may obtain the requisite amount of oxygen from the nitrogen protoxid formed from the nitrates of the soil by bacteria. It is also shown that roots can obtain the oxygen necessary directly from the nitrates if the bacteria are not present. Submersion will not cause suffocation while there is an abundance of nitrogen available.

Investigations on fasciation, A. NESTLER (*Oesterr. bot. Ztschr., 1894, p. 343, pls. 2*).

Concerning the constituents of the membranes of fungi, I, E. WINTERSTEIN (*Ztschr. physiol. Chem., 19, No. 6, pp. 521–562*).

The action of molds on albumen, E. MARCHAL (*Bul. Soc. Micr. Belge, 1893; abs. in Bul. Soc. Bot. France, 41 (1894), No. 5, pp. 403, 404*).

Revision of the tubercles of plants and tuberculoïdes of Leguminosæ, D. CLOS (*Abs. in Bul. Soc. Bot. France, 41 (1894), No. 5, pp. 406–408*).

Root tubercles of Leguminosæ, M. C. C[OOKE] (*Gard. Chron., 16 (1894), ser. 3, pp. 307, 308*).—A résumé, to be continued.

The root tubercles of soja bean, O. KIRCHNER (*Repr. from Beitrag. Biol. Pflanz., 7 (1894), No. 2, pp. 213–223, pl. 1*).

Method for examining seeds of cereals, C. MÜLLER (*Pharm. Central Halle, 35, p. 357; abs. in Chem. Centbl., 1894, II, No. 9, p. 448*).—Directions for mechanical separation of the parts of the kernel for microscopic study.

Root tubercles of alder, etc., M. C. COOKE (*Gard. Chron., 16 (1894), ser. 3, pp. 398*).

The natural history of plants, their forms, growth, reproduction, and distribution, K. VON MARILAUN, translated by F. W. OLIVER. (*London: Blackie, 1894, vol. 1, pp. 386*).

Contribution to the life history of the wheat plant, L. M. BLOOMFIELD (*Ann. Rpt. Ohio Acad. Sci., 2 (1894), pp. 12–14*).

A theory of the strobilus in archegoniate plants, F. O. BOWER (*Ann. Bot., 8 (1894), No. 31, pp. 343–365*).

Concerning the Galton curves as showing discontinued variation, H. DE VRIES (*Ber. deut. bot. Ges., 12 (1894), No. 7, pp. 197–207, pl. 1*).

On the presence of centrospehres in fungi, H. WAGER (*Ann. Bot., 8 (1894), No. 31, pp. 321–334, pl. 1*).

Nucleoli and centrosomes, J. E. HUMPHREY (*Ann. Bot., 8 (1894), No. 31, pp. 373–376*).

Concerning zygmorphic flowers, R. MEISSNER (*Bot. Centbl., 60 (1894), No. 1, pp. 1–15*).

The origin of pectin by the action of lime on the cell wall of the cane, H. C. P. GEERLIGS (*Repr. from Arch. Java Suikerind., 1893, pp. 2*).

Some experiments in transpiration and assimilation, E. STAHL (*Bot. Ztg., 52 (1894), No. 6 and 7, pt. 1, pp. 117–145, pl. 1*).

Practical photomicrography, A. PRINGLE (*London: Iliffe & Son, pp. 160, figs. 29*).

BACTERIOLOGY.

Our secret friends and foes, P. F. FRANKLAND (*London: Society for Promoting Christian Knowledge; New York: E. & J. B. Young & Co., 1894; noticed in Chem. News, 70 (1894), No. 1821, p. 196*).—Popular accounts of microörganisms, useful and otherwise.

Beneficial and injurious bacteria, L. VOLPE (*Almanacco giorn d'Agric. L'Italia Agricola, 1894*).

Rate of fermentation of sugars, W. G. A. ROBERTSON (*Edinb. Med. Jour., 1894, pp. 803–809*).

Alcohol and sugar production by organisms from by-products of sugar manufacture, F. A. F. C. WENT and H. C. P. GEERLIGS (*West Java Sugar Station Contr. 13, pp. 21, pl. 1*).

Action of light on bacteria, H. C. FYFE (*Gard. Chron., 16 (1894), ser. 3, pp. 292, 293*).—Popular account of hygienic and botanical experiments with bacteria.

Anaërobic fermentation produced by Bacillus orthobutylicus and some of its variations under certain biological influences, L. GRIMBERT (*Jour. Pharm. et Chim., 1894, pp. 281–288*).

METEOROLOGY.

Meteorological summary for the United States for 1893, C. ABBE and A. J. HENRY (*U. S. Dept. Agr., Weather Bureau, Monthly Weather Review, 21 (1893), No. 13, pp. VI and 377–390, charts 7*).—A summary of meteorological conditions in the United States is given in notes, table, and charts based upon data furnished by 1,573 regular and voluntary observers of the Weather Bureau:

"The relation between the climate of any region, the growth of vegetation, and the quality of the crops is commonly understood to depend, primarily, upon the actual temperature, sunshine, and moisture. The accumulated sums of these quantities day by day after the seed is sown hold a close relation to the resulting harvest. On the other hand, the seeds that have been raised for many years in succession in the same region have, by a process of acclimatization, attained the property of yielding what may be called a normal crop under normal climatic conditions; hence the departures of the weather for any year from the normal climate may be assumed to

produce corresponding departures of the crop for that year from the nomal crop. From this point of view it has become the custom to publish in the successive Weather Reviews the departures of temperature and rainfall for the respective months as well as the accumulated departures. In order to present a condensed summary of the climatic conditions during the year 1893 tables have been prepared showing all of these accumulated departures. [These tables] have been constructed in the following manner: For each district the departure from the normal for the month of January is shown in the first column, and is expressed in degrees F. and inches of rainfall, respectively; the departures for the month of February, after being added to those of January, give the accumulated departure for that month, as shown in the second column, and so on until the end of the year, so that the departures given in the column for December represent the sum total of the 12 monthly departures. If we wish to find the mean departure from the beginning up to any month in the year, we divide the accumulated departure for that month by the calendar number of the month. . . .

"In general, it will be seen that the year has been cold, and, except in the Middle and South Atlantic States, has steadily progressed from January to December toward greater deficits of temperature. [The table of accumulated departures of precipitation] shows that there has been almost everywhere a deficit of precipitation, and, except in the North Pacific district, a steady movement from month to month toward a greater deficit."

Summary of meteorological records for thirty-six years, 1858-'93 (*Kansas Sta. Rpt. 1893, pp. 16–22, dgms. 2*).—Tables show (1) the precipitation, (2) temperature, and (3) combined rainfall and maximum and minimum temperatures at the college during 36 years, divided into 10-day periods. Diagrams are also given which show the annual precipitation and the mean annual temperature and rainfall curves for the same period. The mean annual precipitation for the whole period was 30.17 in., the mean temperature 52.82° F.

"[From the diagrams it will be seen that] the least rain fell in 1860 and the most in 1876. Probably the most noticeable feature is the wide variations from year to year in the first part of the curve and the much less variations in the last part. The greatest variation from normal in the last 15 years was 7.23 in.; in the preceding 15 years this was exceeded 7 times, the greatest variation from normal being 16.76 in . . . .

"The total rainfall for the first 8 years was 247.24 in., which, divided by 8, gives a mean of 30.91 in. This normal curve seems to be the best test of increase or decrease of rainfall. The normal curve was the lowest in 1875, when it reached 28.17 in. There was a gradual increase to 1884, when it was 30.66 in. This is the highest normal, if we except the first 8 years, when no satisfactory normal could be established. Since 1884 there has been a nearly uniform decrease of normal until, in 1893, it was 30.17 in. . . .

"The temperature curve is quite regular, being the lowest in the second decade of January, with a mean of 23.19° F., and the highest the second decade of July, when the mean reached 78.70°. There is a cold spell the first decade of February, made somewhat more prominent by warm periods the last of January and the middle of February.

"In general, it may be said that the rainfall varies with the temperature. This is shown in the general outline of the two curves. The irregularities in the rainfall curve seem to be accidental, such as would be obtained from a single year; when, however, it is remembered that this curve is the mean of 36 years, it will be seen that these irregularities are quite certain to occur. Assuming that the rainfall should follow the temperature, 3 serious dry periods of more or less extent may be noted,

the first beginning with the 21st of February and continuing to the 20th of March. This is the period so trying to winter wheat, and much of the winterkilled wheat can be traced to this lack of rainfall, rather than to extremes of temperature. The next threatening dry period is the first decade of July. This is a short period, and the previous wet period makes it less noticeable. This period is accompanied by a rapidly rising temperature to almost the maximum, and frequently by hot winds. This may result in so much injury to growing corn that the following wet period can not overcome it.

"The most serious dry period, on account of its duration, runs through August, September, and the first 10 days in October. It is this period that is especially trying to corn, late potatoes, and fall fruits. Two and one-fourth inches of rainfall during this period would bring the rainfall curve up to the temperature curve.

"Probably 1 in. of rain properly distributed would carry crops safely over this period. This suggests the good that might be done with a small amount of water applied at the right time.

"The wet period in the middle of May frequently prevents the proper cultivation of crops, especially if continued to the end of June. The advantage that might naturally be expected from our wet years is often lost by this season becoming too wet and cold, the cold being indicated by a slight depression of the temperature curve. It is not claimed that any or all of these periods are present each year. Noted examples in recent years of injury to winter wheat by the spring drought are 1879, 1880, 1881, 1885, and 1887. Great injury to corn resulted from the July drought of 1881, 1887, 1890, and 1893. The tendency to form the dry periods mentioned is clearly seen in 1882, but a cool July and August, with a warm spring and fall, gave the unusually large crops of that year on 2 in. less rainfall than normal."

Meteorology, C. H. JOHNSON (*Massachusetts State Sta. Rpt. 1893, pp. 390–395*).—The most conspicuous meteorological phenomena of 1893 are briefly referred to, and monthly summaries of observations on temperature, humidity, precipitation, wind movement, etc., are tabulated, with notes on casual phenomena. The summary for the year is as follows: Mean temperature (degrees F.), 44.55; precipitation (inches), total, 43.22; mean monthly 3.60, highest monthly, 5.55 (February); lowest monthly, 2.57 (September); snow fall, 86.5; mean dew point, 58.17; mean relative humidity, 79.76; prevailing direction of wind, NW.

Meteorological summary for July, 1894 (*Massachusetts State Sta. Bul. 54, p. 1*).—Brief notes on the weather and condition of crops and a summary of observations on temperature, rainfall, and wind movement are given.

Meteorological summary for North Carolina for June, 1894 (*North Carolina Sta. State Weather Service Bul. 57, pp. 87–100, maps 2*).—Daily and monthly summaries of observation by the State weather service coöperating with the Weather Bureau of this Department.

WATER—SOILS.

The action of lime on the flocculation of different soils, R. SACHSSE and A. BECKER (*Landw. Vers. Stat., 45 (1894), No. 1 and 2, pp. 137–146*).—In continuation of previous experiments[1] the author tested the flocculating power of lime on the following kinds of soil: (1) A deep alluvial loam, (2) an æolian loess, (3) a clayey loess loam, (4) a heavy clay soil, and (5) and (6) meadow loams. Only portions of

[1] Landw. Vers. Stat., 43 (1894), No. 1 and 2, pp. 15–25 (E. S. R., 5, p. 695).

these soils of the same hydraulic value (under 0.01 mm. in diameter), as determined by Schöne's apparatus, were used. These were flocculated as in previous experiments, and in order to find the cause of the great variation in flocculation observed the original soil and the flocculated and the nonflocculated parts were examined with reference to their content of sand and clay (insoluble in hydrochloric acid) and zeolites (soluble in hydrochloric acid). From the results the proportion of sand and clay, and zeolites flocculated and not flocculated, and the composition of the zeolites in the original, flocculated, and nonflocculated portions are calculated.

No definite relation between the water content of the sand and clay (insoluble portion) of the different soils and their susceptibility to flocculation was traced. Beyond this, no conclusions are deemed warranted at the present stage of the investigation.

Water and water analyses, C. W. MCCURDY (*Idaho Sta. Bul. 8, pp. 25*).—A general discussion on water and water supply, accompanied by analyses of 27 samples of water collected in and around Moscow, Idaho, or sent in from other parts of the State. A scale of prices for water analyses is appended.

Analyses of water (*Massachusetts State Sta. Rpt. 1893, pp. 332–335*).—Analyses of 93 samples of water with reference to fitness for domestic use are reported with rules for interpreting the results.

The chemical composition of the atmosphere, T. L. PHIPSON (*Compt. Rend., 119 (1894), No. 8, pp. 444–446*).

Concerning the rainfall and nitrogen content of the rain water, T. MARR (*East Java Expt. Sta. Contr. 47, pp. 63–67*).

Investigations concerning the relation of atmospheric precipitation to plants and soils, E. WOLLNY (*Forsch. Geb. agr. Phys., 17 (1894), No. 3 and 4, pp. 350–372*).

Bacteriological examination of potable water (*Abs. in Chem. News, 70 (1894), No. 1817, p. 149*).

Microörganisms in water, their significance, identification, and removal, P. FRANKLAND (*London: Longmans, Green & Co.; reviewed in Analyst, 1894, Aug., p. 192*).

Electrical sanitation, C. W. CHANCELLOR (*U. S. Consular Rpt. 1894, Aug., pp. 639–642*).—A discussion of the purification of sewage waters by means of the decomposition of chlorid of magnesia effected by the electric current.

Preliminary work on some Kentucky marls, A. M. PETER (*Kentucky Sta. Rpt. 1892, pp. 36–42*).—A reprint of Bulletin 39 of the station (E. S. R., 3, p. 792).

Analyses of soils (*Massachusetts State Sta. Rpt. 1893, pp. 324, 325*).—Chemical analyses of 3 samples.

Advantages and effects of deep plowing, L. GRANDEAU (*Jour. Agr. Prat., 58 (1894), No. 4, pp. 487–490*).—A popular article, with determinations of the water content of soil.

Studies in moor culture, KOEHL (*Forstw. Centbl., 16 (1894), No. 9 and 10, pp. 452–470*).—(To be continued.)

Investigations relating to the modifying of the physical properties of moor soils by mixing and covering with sand, E. WOLLNY (*Forsch. Geb. agr. Phys., 17 (1894), No. 3 and 4, pp. 229–290*).

The amount and the rôle of carbonate of lime in arable soils, A. BERNARD (*Rev. Agr. Île Maurice, 8 (1894), No. 7, pp. 154–160*).—(Continued.)

Agricultural charts of the Canton of Ferté-sous-Jouarre (*Jour. Agr. Prat., 58 (1894), No. 39, pp. 462–465, fig. 1*).

FERTILIZERS.

The assimilation of humus and organic substances by plants, E. BRÉAL (*Ann. Agron., 20 (1894), No. 8, pp. 353–370*).—The presence in the soil of the brown or black substance resulting from the slow decomposition of former vegetation, known as humus, has long been popularly considered an index of fertility. This humus, however, is a substance of very variable composition, undergoing constant change due to oxidation under the influence of numerous organisms. Decomposition of humus is more active the higher the temperature. This accounts for the small percentage of humus in soils of hot dry regions.[1] Boussingault observed more than 40 years ago that peat bogs do not occur in the tropics except at an altitude of 1,000 meters or more above the sea.

It has been held by many leading investigators of the subject that humus has little practical significance as a direct food for plants, although it has been shown that certain of its constituents may be absorbed and assimilated by plants,[2] and this view seems to be strengthened by the fact that well-developed plants have been grown repeatedly in a soil free from humus or in solutions containing only mineral salts.

In comparative tests by Dehérain of chemical fertilizers and organic manures on a large number of crops carried on for several years the yield has invariably been higher on the plats supplied with humus-forming manures. The results indicate, moreover, that the fertility declined as the proportion of humus in the soil decreased.[3]

In support of the view that plants assimilate organic matter directly, the author cites the cases of the assimilation of humus by the roots of certain trees, such as chestnuts, oaks, and beeches, by means of mycorrhiza as observed by Frank; the utilization by fungi of the organic compounds elaborated by algæ, as in lichens; the insectivorous habits of certain plants, such as *Drosera rotundifolia;* the symbiosis of leguminous plants with bacteria of their root tubercles; and the celebrated experiments of Böhm, in which bean plants kept in darkness until the starch had disappeared had the starch restored by having the stems and leaves placed in a solution of sugar.

The author placed recently germinated plantlets of lentils, wheat, and beans in (1) a solution of nitrate and phosphate of potash, (2) a

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[1] See F. W. Dafert and A. B. Cavalcanti's report on the soils of São Paulo, Brazil. (Relat. Inst. Agron., São Paulo, 1893, pp. 69–72; E. S. R., 6, p. 199); and E. W. Hilgard and M. E. Jaffa on the nitrogen contents of soil humus in arid and humid regions (Agl. Sci., 8 (1894), No. 4, p. 165; E. S. R., 6, p. 197).

[2] See E. S. R., 5, p. 832.

[3] See H. Snyder on the composition of native and cultivated soils, and the effect of continuous cultivation upon fertility (Minn. Sta. Bul. 30; E. S. R., 5, p. 857).

dilute solution of humate of lime, and (3) ordinary water. The plantlets grown in the humate solution developed much more rapidly than those grown in either of the other solutions. To get still more positive evidence of the assimilation of humus by plants a tuft of *Poa annua* was extracted from the soil, the roots cut off, and the tuft placed in water until new white roots had developed. The tuft was then divided into two parts, from one of which the upper part of the plant was removed. Each part was placed in a highly colored solution of humate of potash. After 2 days the humus had almost entirely disappeared in the solution in which the roots with tops attached had been placed, while the solution in which the detached roots had been placed was apparently unaltered.

The experiments of Sachs, in which tracings were obtained on marble by the action of the roots of bean plants, were repeated with a tuft of *Poa*, substituting a piece of filter paper covered with humic acid for the marble slab. The tracings which Sachs obtained were reproduced on the black layer of humus.

It is a well-known fact that when the soil in which plants are growing is abundantly supplied with plant food the roots remain short and thick, while in poor soils they spread out to a great distance. A tuft of *Poa*, provided with aquatic roots produced as described above, was suspended between two flasks, one half of the roots hanging in one flask containing water to which 1 gm. of phosphate of potash per liter had been added, and the other half in the second flask containing water to which had been added, in addition to the above proportion of phosphate of potash, sufficient humate of potash to render the solution brown. At the end of 2 weeks the roots in the flask without organic matter had attained twice the length of those in the other flask.

Experiments with humate of soda gave the same results as those with humate of potash. Other experiments showed that the *Poa* plants assimilated sugar with great rapidity when their roots were immersed in a solution of this substance.

These experiments seem to warrant the conclusion that plants are able to absorb carbonaceous organic substances through their roots, and that they derive great benefit from this supply of plant food.

The doubt which has been cast upon the ability of plants to directly absorb and assimilate the organic matter of the soil would appear to be dispelled by the results here reported.

Intensive culture with chemical fertilizers is the cause of a serious loss of organic matter in the soil. Dehérain, who has shown that the fertility of a soil declines as the humus content decreases, has called attention to the danger from this source. At the same time he has proposed a remedy, viz, the culture of catch crops to prevent the oxidation of humus and loss by drainage and to furnish in autumn a mass of vegetable matter to be turned in as green manure.

The action of nitrates on the assimilability of potash in poor sandy soils, P. PICHARD (*Compt. Rend., 119 (1894), No. 10, pp. 471–473*). Three series of experiments on White Burley tobacco grown on fine, white, siliceous sand are reported. In these nitrogen was furnished in the form of nitrate of soda, nitrate of lime, nitrate of magnesia, and peanut cake; phosphoric acid in the form of superphosphate, phosphate of soda, phosphate of potash, phosphate of lime, and phosphate of magnesia; and potash in the form of nitrate, sulphate, and phosphate.

Of the 5.6 gm. of insoluble potash which the soil contained the tobacco which received the nitrate of lime, nitrate of soda, and nitrate of magnesia assimilated, respectively, 0.66, 3.21, and 0.48 gm. Practically the same results were obtained where peanut cake was applied, especially when nitrification was promoted by applications of phosphate or carbonate of lime. The amounts of insoluble potash assimilated by the plants varied from 1.02 to 3.04 gm., the highest amount being assimilated where carbonate of lime was applied.

This beneficial action of nitrates in increasing the assimilability of potash is undoubtedly not peculiar to tobacco, but would be manifested in case of other plants, especially the potato, which belongs to the same family and has similar fertilizer requirements.

It has been observed that on the siliceous soils of Brittany, which are poor in assimilable potash and lime and rich in organic nitrogen, the application of lime or carbonate of lime increased the yield of fodder beets fourfold to sixfold. Land plaster, in addition to the lime or carbonate of lime, still further increased the yield.

Viticulturists find the continued use of plaster in soils rich in organic nitrogen profitable on account of its action in promoting nitrification and the consequent assimilation of potash, for it is probable that the beneficial effect resulting from the use of various calcareous manures is due not only to the nitrates formed but to their indirect action in promoting the assimilability of potash.

In view of these facts the amount of potash in a soil soluble in *aqua regia* can no longer be considered as the extreme limit of assimilability of this element, but it becomes necessary to determine the total combined potash.

Fertilizers, how to make and how to use them, A. A. PERSONS (*Florida Sta. Bul. 22, pp. 47*).—The principles underlying the use of fertilizers, the nature of the various fertilizing materials in common use, and the fertilizer requirements of different crops are discussed, and formulas for compounding fertilizers for different crops as calculated by Sempers[1] are given.

The use of mixed fertilizers, J. B. LAWES (*Rural New Yorker, 1894, Sept. 8, p. 565*).—Popular article.

Progress in the domain of fertilizing, with special reference to liming, O. SCHILLENBERGER (*Fühling's Landw. Ztg., 43 (1894), No. 17, pp. 533–545; No. 18, pp. 557–565*).

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[1] Manures: How to Make and How to Use Them.

Fertilizers in feeding stuffs, their properties and uses, B. DYER (*London : Crosby, Lockwood & Son, 1894, pp. 122; noticed in Chem. News, 70 (1894), No. 1819, p. 170*).

The storage of farmyard manure, F. NASH (*Rev. Agr. Île Maurice, 8 (1894), No. 7, pp. 149–153*).—Practical conclusions from compiled data.

The care and management of farm manure in South India, C. BENSON (*Dept. of Land Records and Agr., Madras, Bul. 31, pp. 297–300*).—The unfortunate neglect of manure in this part of India is pointed out and improved methods of management are briefly described, the deep stall or impacted manure system being especially commended.

Peat manure, L. DUMAS (*Jour. Agr. Prat. 58 (1894), No. 39, pp. 468–471*).

Analysis of rabbit manure and of the waste in the manufacture of wood excelsior, A. PETERMANN (*Bul. Min. Agr. Belgique, 10 (1894), No. 1, pp. 92–95*).

The form of phosphoric acid to be applied to soils (*Rev. Agr. Île Maurice, 8 (1894), No. 7, pp. 161–163*).—A brief popular article.

On the solubility of phosphoric acid and Ehrmanniet (phosphate of lime), H. C. P. GEERLIGS (*West Java Sugar Sta. Contr. 14, pp. 11*).

The decomposition of silicates by ferrous and manganous oxids, R. SACHSSE and A. BECKER (*Landw. Vers. Stat., 45 (1894), No. 1 and 2, pp. 147–151*).

Commercial fertilizers, M. A. SCOVELL (*Kentucky Sta. Rpt. 1891, pp. 68–86, 99–101*).—Reprints of Bulletins 34 and 36 of the station (E. S. R., 3, pp. 227, 791).

Commercial fertilizers, M. A. SCOVELL (*Kentucky Sta. Rpt. 1892, pp. 89–107, 120–122*).—Reprints of Bulletins 41 and 43 of the station (E. S. R., 4, pp. 248, 643).

Commercial fertilizers, A. M. PETER (*Kentucky Sta. Rpt. 1893, pp. 71–87*).—A reprint of Bulletin 46 of the station (E. S. R., 5, p. 290).

Fertilizer inspection and analysis in Maryland (*Maryland Sta. Bul. 27, pp. 97–132*).—This includes tabulated analyses of 181 samples of fertilizers examined March to July, 1894; a list of fertilizer manufacturers, with names of brands licensed August 6, 1894; a schedule of trade values, with notes on valuation; and the text of the amended State fertilizer law approved by the governor April 6, 1894.

Inspection of fertilizers in Massachusetts (*Massachusetts State Sta. Rpt. 1893, pp. 264–323*).—This includes general remarks on the conduct of the fertilizer control and on valuation, State laws relating to fertilizers, a list of licensed manufacturers and dealers, and tabulated analyses of 335 samples of fertilizer materials, including compound fertilizers, bone, dissolved boneblack, odorless phosphate, Florida phosphate, South Carolina floats, double superphosphate, phosphate of ammonia, phosphate of potash, sulphate of potash, muriate of potash, carbonate of potash, nitrate of soda, saltpeter waste, castor pomace, cotton-seed meal, wood ashes, cotton-hull ashes, swill ashes, logwood ashes, sewage, boiler soot, sulphate of soda, mill sweepings, peat, muck, canal mud, and stable manure.

Fertilizer inspection and analysis in Massachusetts (*Massachusetts State Sta. Bul. 54, pp. 2–8*).—A schedule of trade values of fertilizing ingredients is given, with tabulated analyses of 77 samples of fertilizing materials, including compound fertilizers, wood ashes, muriate of potash, cotton-seed meal, dried ground fish, hair waste, cotton waste, refuse from calico works, marl, and seaweed.

Compiled analyses of fertilizers, C. S. CROCKER (*Massachusetts State Sta. Rpt. 1893, pp. 337–345*).—Tables show the averages of the results of analyses made at Amherst, Massachusetts, from 1868 to 1893, of a large number of fertilizing materials.

Fertilizer inspection and analysis in New York (*New York State Sta. Bul. 73, n. ser., pp. 347–379*).—A schedule of trade values of fertilizing materials, a scale of prices for fertilizing ingredients in foods, and tabulated analyses of 186 samples of fertilizers collected during the spring of 1894.

FIELD CROPS.

Experiments with different phosphates on corn, C. A. GOESSMANN (*Massachusetts State Sta. Rpt. 1893, pp. 221–225*).—Phosphatic slag, Mona guano, Florida rock phosphate, South Carolina floats, each at the rate of 850 lbs. per acre, and dissolved bone at the rate of 500 lbs. per acre, were applied in connection with a constant quantity of nitrogen and potash. The fertilizer applied to each plat cost the same amount. The largest yields of ears occurred where ground Mona guano and South Carolina phosphate were used, the largest yield of stover with phosphatic slag.

Ash analyses of corn (*Kentucky Sta. Rpt. 1891, pp. 13–17*).—In connection with a fertilizer experiment on corn described in Bulletin No. 17 of the station (E. S. R., 1, p. 61) analyses were made of the corn stover, corn cobs, shelled corn, and whole crop of corn grown with different fertilizers. The result of these analyses are tabulated.

"It is interesting to note that, although the soil of this field seems to be deficient in potash and responds promptly to an application of potash fertilizers, yet the per cent of potash in the water-free crop is nearly uniform, whether the fertilizer used contained potash or not. The phosphoric acid, however, varies considerably, and the crop seems to find abundance of nitrogen at its disposal, removing in each case more than was applied in the fertilizer."

Experiments in crossing for the purpose of improving the cotton fiber, P. H. MELL (*Alabama College Sta. Bul. 56, pp. 47, figs. 9, pls. 4*).

Synopsis.—A classification of varieties of cotton, a study of the length and strength of fiber as affected by crossing, a study of the properties of a well-formed cotton fiber, tabulated data giving results of crossing varieties, and photo-micrographs of the fiber and open bolls of crosses and varieties.

An illustrated popular description is given of the cotton flower and of the method of pollination, general remarks on improvement of the fiber by crossing, and a description of experiments in this line.

Classification of varieties (pp. 13–15).—The varieties studied were arranged in 7 groups, according to the length of staple, productiveness, form of leaves, length of limbs, habit of fruiting, size of bolls, and character of seed. The groups were as follows: (1) Allen Long Staple, W. A. Cook, Hunnicutt, Jones Long Staple, Wonderful; (2) Baily, Okra Leaf; (3) Cherry Cluster, Herlong, Peerless, Welborn Pet; (4) J. C. Cook; (5) Barnett, Dixon, Hawkins Improved, Jones Improved, Keith, King, Rameses, Truitt; (6) Gold Dust; (7) Peterkin, Peeler, Petit Gulf, Storm Proof, Southern Hope, Zellner.

Effect of crossing on the fiber (pp. 18, 19).—Experiments in crossing a number of varieties on Peerless and W. A. Cook are described, and plates given showing the results of the crosses.

The following table gives the weight of lint per boll and the length of fiber for the crosses and the averages for the parents used in each case:

Influence of crossing varieties of cotton on the yield of lint per boll and on the length of fiber.

Variety.	Weight of lint per boll.		Length of fiber.	
	Cross.	Average for parents.	Cross.	Average for parents.
	Grams.	*Grams.*	*Inches.*	*Inches.*
Barnett × Peerless	2.244	1.744	1.10	0.94
Truett × Peerless	2.580	2.085	1.10	0.89
Cherry Cluster × Cook	1.979	2.465	1.30	1.20
Petit Gulf × Peerless	3.214	2.251	0.90	0.94
King × Cook	2.007	2.135	1.00	1.10
Rust Proof × Peerless	2.396	2.229	1.00	....
Peterkin × Peerless	2.630	2.125	1.10	0.94
Wonderful × Peerless	2.575	2.087	1.20	1.11
Petit Gulf × Cook	2.507	2.746	0.90	1.25
Allen Long Staple × Peerless	2.194	1.893	1.30	1.09
Wonderful × Peerless	2.490	2.087	1.20	1.11
Welborn Pet × Peerless	1.394	1.320	0.90	0.89
Jones Long Staple × Peerless	2.500	2.156	1.20	1.06
Peerless × Cook	1.941	2.246	1.40	1.19
Zellner × Cook	1.653	2.289	1.40	1.20
Okra Leaf × Peerless	2.630	1.801	1.10	1.04
Wonderful × Peerless	2.660	2.087	1.00	1.11
Peeler × Peerless	2.216	2.037	1.20	1.04
Hawkins Improved × Peerless	2.346	1.424	1.20	0.87
Truitt × Cook	2.554	2.580	1.20	1.20
J. C. Cook × Peerless	1.793	....	1.40	....
Cherry Cluster × Cook	2.545	2.465	1.20	1.20
Jones Improved × Peerless	2.490	2.246	1.20	0.89
Barnett × Cook	2.090	2.239	1.40	1.25
Peeler × Cook	2.252	2.531	1.40	1.35

In most cases the length and strength of fiber of crossed plants were greater than the length and strength of fiber of parent plants. Plants which were strong and vigorous from the start and which grew slowly from large and well-developed stalks gave fiber of the best quality. The proportion of lint to seed cotton was in most cases less with the crossed plants than with the parents. The absolute amount of lint per boll was, however, greater in the crosses than in the parent plants. In most cases the size of seed was increased by crossing, a result probably due to the fact that the female parents, Peerless and W. A. Cook, are varieties with large seed.

Properties of a well-formed cotton fiber (pp. 19–21).—The qualities desired in a cotton fiber are (1) complete maturity throughout the entire length, (2) uniform twist from end to end, (3) uniform width in all parts, (4) maximum length, and (5) purity in color.

Tabulated data are given for each variety and for each cross regarding the length of branches; height of stalk; number of lobes per leaf; number of bolls per limb; shape and measurements of boll; productiveness and time of maturity of plant; character of the seed; length, diameter, strength, and weight per boll of fiber; number of seeds per boll; weight of seed; proportion of lint to seed cotton; and condition of fiber with reference to twist and degree of maturity.

Influence of fertilizers on composition of cotton, J. T. ANDERSON (*Alabama College Sta. Bul. 57, pp. 16*).—Cotton stalks from small plats differently fertilized were analyzed early in June when in the early flowering stage, and about 3 months later when the plants were full of unopened bolls. In the last case the immature seeds were not included in the analysis. One series of plats was located on a soil too poor for the profitable cultivation of cotton, the other on a garden soil. The following table gives a summary of results obtained:

Effect of fertilizers on composition of the dry matter of cotton plants.

	In flowering stage.		In boll-bearing stage.	
	Field.	Garden.	Field.	Garden.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Potash in crop when potash was applied	2.356	3.254	2.268	2.610
Potash in crop when potash was not applied	2.062	3.240	1.154	2.238
Increase with potash	14.250	0.430	96.530	16.620
Phosphoric acid in crop when phosphoric acid was applied	0.807	0.856	0.527	0.761
Phosphoric acid in crop when phosphoric acid was not applied	0.828	0.853	0.566	0.741
Increase with phosphoric acid	—2.530	0.350	—6.890	2.700
Nitrogen in crop when nitrogen was applied	3.773	4.095	1.895	2.280
Nitrogen in crop when nitrogen was not applied	3.618	3.819	1.862	2.356
Increase with nitrogen	4.280	7.230	1.770	—3.220

In both poor and rich soils potash fertilizer increased the percentage of potash in the dry matter of the plant. The nitrogen content of the plants in the flowering stage, both in field and garden, was increased by nitrogenous fertilizers. The effect of a nitrogenous fertilizer on the composition of the older plant was not so marked. The influence of phosphoric acid was not clearly indicated.

"Where we have high percentages of two or more constituents in the flowering stage, and a relatively low decrease of those percentages in passing to the bolling stage, we have, generally speaking, a large yield. On the other hand, low, or even average, percentages in the early, and a large decrease of the same in the latter stage, showing an insufficient supply from the soil, means a relatively low yield."

Analyses of the soil of field and garden and yield of seed cotton in ounces are given. The yield was greatest when a complete fertilizer was applied.

Experiments with grasses and potatoes, C. A. GOESSMANN (*Massachusetts State Sta. Rpt. 1893, pp. 193–199*).—An experiment with Kentucky blue grass, meadow fescue, timothy, and various mixtures of grasses, continued through a number of years, led to the following conclusions:

"(1) Italian rye grass is less liable to be winterkilled with us than English rye grass.

"(2) Meadow fescue furnishes a valuable grass, as far as a continuation of a healthy growth during a series of years is concerned, and excels in that respect the herds grass.

"(3) Grass mixtures as a rule yield larger crops than the same varieties when cultivated by themselves."

On 3 varieties of potatoes identical amounts of potash, supplied either in the form of muriate or high-grade sulphate of potash, were applied in connection with a constant quantity of bone. With all 3 varieties the yield was greater when sulphate of potash was used. Beauty of Hebron yielded more than New Queen or Clark.

Fertilizer experiments on oats, C. A. GOESSMANN (*Massachusetts State Sta. Rpt. 1893, pp. 184–192*).—Forty-five pounds of nitrogen per acre in the form of nitrate of soda, of dried blood, or of sulphate of ammonia was applied in connection with 80 lbs. of phosphoric acid and 125 lbs. of potash per acre to plats similarly manured during the preceding 5 years. Two plats received only phosphoric acid and potash. The object of the experiment was to ascertain the relative value of the different forms of nitrogen and to learn if the roots and stubble of the leguminous crop, soja bean, which had occupied the land in the preceding year, had notably increased the amount of available nitrogen in the soil.

The oat plants on the plats to which dried blood was applied were especially dark green in color. The average yield of grain on the eighth-acre plats receiving sulphate of ammonia was 92 lbs., on those receiving dried blood or stable manure 140⅔ lbs., and on those receiving nitrate of soda 140½ lbs. Where sulphate of ammonia was used there was a heavy yield of straw without a corresponding increase in the yield of grain.

"The total yield of crop on the plats receiving no nitrogen addition, as compared with those receiving a nitrogen supply, was: With oats in 1890, one fifth to one sixth less; with rye in 1891, one fifth to one sixth less; with soja beans in 1892, one third to one fourth less; with oats in 1893, one seventh to one eighth less.

"From this it will appear that the introduction of a leguminous crop into our rotation has somewhat reduced the difference in yield between the plats receiving no nitrogen and those receiving it, yet has not entirely obliterated it."

The effect on the yield of potatoes of digging a part of the tubers early, A. LEYDHECKER (*Oesterr. landw. Wochenbl.; abs. in Braunschw. landw. Ztg., 62 (1894), No. 28, pp. 122, 123*).—May 18, entire tubers were planted 3.2 in. deep at distances of 12 by 18 in. In one part of the field all the tubers on 1 plat were dug September 23, at which time vegetation had ceased. On another plat the largest tubers were dug July 27 and the remainder of the crop September 23. The yields per plat, of which the area is not given, were as follows:

Effect of fractional harvesting on yield of potatoes.

	Large potatoes, dug July 27.	Large potatoes, dug Sept. 23.	Small potatoes, dug Sept. 23.	Total large and small potatoes.
	Kg.	*Kg.*	*Kg.*	*Kg.*
Digging once	....	72.4	14.8	87.2
Digging twice	24.8	64.0	14.0	102.8

Here digging twice increased the yield by 15.6 kg. per plat. The yield of small potatoes was practically identical, the increase on the plat dug twice occurring almost entirely in the large tubers.

In a second section of the same field the potatoes on 1 plat were dug September 23. On another plat 3 fractional harvests were gathered—July 27, August 11, and September 23. The yields of tubers were as follows:

Effect of fractional harvesting on yield of potatoes.

	Large potatoes, dug July 27.	Large potatoes, dug Aug. 11.	Large potatoes, dug Sept. 23.	Small potatoes, dug Sept. 23.	Total large and small potatoes.
	Kg.	*Kg.*	*Kg.*	*Kg.*	*Kg.*
Digging once	....	....	96	10.4	106.4
Digging 3 times	21.6	22	48	10.4	102.0

Here we have a loss of 4.4 kg. as the result of digging 3 times. Of course the employment of the increased amount of labor required in fractional harvesting would be justifiable only by a considerable increase in yield or by relatively high prices for the tubers dug early.

Effect of green manuring on potatoes, H. CLAUSEN (*Deut. landw. Presse*, *21* (*1894*), *No. 66*, *p. 633*).—Rye was grown with lupines or red clover on plats of 10 square meters, the red clover being sown either at the same time as the rye or after the rye had attained some height. The rye was harvested and the leguminous crops were plowed under (time not stated), and potatoes grown on the plats the following season. The yields of rye and potatoes were as follows:

Effect of green manures on yield of potatoes.

Crop in 1892.	Yield per acre of rye in 1892.	Yield per acre of potatoes in 1893.
	Pounds.	*Pounds.*
Rye alone	828	17,375
Rye and lupines	823	19,825
Rye alone	842	16,261
Do	861	17,775
Rye and late-sown red clover	778	19,825
Rye and early-sown red clover	707	25,839

It appears from the table that neither the lupines nor the late-sown clover reduced the yield of rye to any considerable extent. Although the early-sown clover reduced the yield of rye more than that sown late, it was much more effective than the latter in increasing the crop of potatoes the following year.

Experiments in applying potash salts to sugar beets on rich soils, A. PETERMANN and G. DE MARNEFFE (*Bul. Min. Agr. Belgique*, *10* (*1894*), *No. 1*, *pp. 77–91*).—In experiments on sugar beets, carried out during 1883–'89 on a sandy argillaceous soil containing in the arable layer 0.078 per cent of potash soluble in hydrochloric acid and 1.89 per

cent of potash soluble in hydrofluoric acid, it was observed that muriate of potash, applied at rates of 50, 75, and 100 kg. of potash per hectare in addition to a basal fertilizer of 60 kg. of nitric nitrogen and 120 kg. of phosphoric acid, resulted in a loss in every case. The decrease in the elaboration of sugar was attributed to the harmful influence of the chlorids. This decrease was greater the nearer the time of application approached the time of seeding, and in some cases it was sufficiently great to counterbalance the advantage resulting from the slight increase in total yield. The replacement of the muriate by sulphate, and especially by phosphate of potash, increased the sugar content up to and even beyond that observed on the plats without fertilizer and on those fertilized with nitrogen and phosphoric acid only. Nitrate of potash was equally favorable to the elaboration of sugar, and it yielded beets having as high a content of sugar as those grown on plats without fertilizer or on those receiving fertilizer without potash; but the benefit derived from the use of this salt was not sensibly greater than that produced by the application of nitrate of soda and superphosphate without potash. It appears that under the soil conditions, etc., which obtained in these experiments and which are frequently encountered in practice, it is not necessary to apply potash in order to obtain the maximum yield, but it is probable that the elaboration of sugar would be promoted by adding to a basal fertilizer of 400 to 450 kg. of nitrate of soda and 800 to 900 kg. of superphosphate, 50 to 75 kg. of potassium in the form of sulphate or preferably in the form of phosphate, in the last case the quantity of superphosphate being reduced in proportion to the amount of phosphoric acid contained in the phosphate of potash.

Fertilizer experiments on barley, corn, vetch and oats, Scotch tares, soja bean, oats, and Canada peas and oats, C. A. GOESSMANN (*Massachusetts State Sta. Rpt. 1893, pp. 227–236*).—Since 1889, 5 plats devoted to this experiment received annually the same fertilizer, either 10 tons of barnyard manure per acre or a ton of wood ashes or 600 lbs. of ground bone and 200 lbs. of muriate of potash, or 600 lbs. of ground bone and 400 lbs. of sulphate of magnesia. One plat was unfertilized.

All the fertilizers considerably increased the yield over the unfertilized plat. Sulphate of potash and magnesia gave in most instances on leguminous plants better results than muriate of potash. On grain crops muriate of potash in most cases gave better results than the sulphate of potash and magnesia. Incidentally, the advantage of seeding grain and soja beans in drills was brought out.

Report of agriculturist and horticulturist for 1893 (*Nevada Sta. Rpt. 1893, pp. 11–24*).—Experiments in applying gypsum to alfalfa, culture experiments with potatoes, tests of 67 varieties of potatoes, 28 of wheat, 14 of oats, 12 of barley, 7 of corn fodder, 18 of sugar beets, 8 of tobacco, and 8 of carrots. With potatoes, planting April 1 gave better results with most varieties than later planting. The "seed"

end of potatoes germinated better, and hence gave a larger yield than the stem end. Five to 7 in. was found to be the best depth for planting potatoes.

Mammoth clover, red clover, rye grass, alsike clover, brome grass, scarlet clover, meadow fescue, Folsom grass, orchard grass, crimson trefoil, Japan clover, meadow oat grass, timothy, white clover, sainfoin, Kentucky blue grass, and Bermuda grass were grown. Brief notes are given on cauliflowers, on a tool house recently constructed, on treating wheat for smut, and on exhibits made during the year.

Relation between the size of the embryo of a grain of wheat and the size and weight of the entire grain, H. MICHEELS (*Bul. Min. Agr. Belgique, 10 (1894), No. 1, pp. 96–102*).—The author examined a number of grains of wheat from different countries. In the case of each kind of wheat investigated the length and breadth of the embryo increased with the weight of the grain of wheat. Of 2 grains of wheat of equal size, the heavier generally contained the larger embryo. The size of the embryo in general diminished less rapidly than the weight of the grain.

Experiments with corn, M. A. SCOVELL (*Kentucky Sta. Rpt. 1891, pp. 57–67*).—A reprint of Bulletin 33 of the station (E. S. R., 2, p. 724).

The evolution of Indian corn, W. A. KELLERMAN (*Ann. Rpt. Ohio Acad. Sci., 2 (1894), pp. 32, 33*).

Experiments with forage plants, C. A. GOESSMANN (*Massachusetts State Sta. Rpt. 1893, pp. 212–219, pls. 4*).—Analyses and notes on the growth of the following plants: White lupine (*Lupinus albus*), yellow lupine (*L. luteus*), prickley comfrey (*Symphytum officinale*), flat pea (*Lathyrus sylvestris*), 3 varieties of soja bean (*Soja hispida*), kidney vetch (*Anthyllis vulneraria*), sainfoin (*Onobrychis sativa*), cowpea (*Dolichos sinensis*), serradella (*Ornithopus sativus*), spring vetch (*Vicia sativa*), Bokhara clover (*Melilotus alba*), horse bean (*Vicia faba*), Kaffir corn, 3 varieties of buckwheat (*Fagopyrum esculentum*), summer rape (*Brassica napus*), and carrots (*Daucus carota*). An early variety of black soja bean proved superior as a forage plant to other varieties. Serradella made a heavy growth, Kaffir corn failed to mature, and Japanese buckwheat gave a heavier growth than the common and silver-hull varieties.

Forage plants, H. GARMAN (*Kentucky Sta. Rpt. 1893, pp. 16–22*).—Descriptive notes on tall fescue (*Festuca elatior*), meadow fescue (*F. pratensis*), red fescue (*F. rubra*), orchard grass (*Dactylis glomerata*), rescue grass (*Bromus schraderi*), English rye grass (*Lolium perenne*), crimson clover (*Trifolium incarnatum*) mammoth or pea-vine clover (*T. medium*), alsike clover (*T. hybridum*), alfalfa (*Medicago sativa*), black medic (*M. lupulina*), Japan clover (*Lespedeza striata*), Bokhara clover (*Melilotus alba*), spurry (*Spergula arvensis*), Johnson grass (*Sorghum halapense*), and kidney vetch (*Anthyllis vulneraria*).

Forage plants for the South, S. M. TRACY (*U. S. Dept. Agr., Farmers' Bul. 18, pp. 30*).—A summary of this bulletin was given in E. S. R., 6, p. 92.

The cultivation of ginseng, A. COX (*Amer. Agr. (middle ed.), 54 (1894), No. 5, pp. 121, 122, figs. 3*).

The cultivation and manufacture of ganja in Madras, C. BENSON (*Dept. Land Records and Agr., Madras, 1894, Bul. 29, pp. 291–294*).—Popular notes on the cultivation and manufacture of hemp (*Cannabis sativa*).

Soil inoculation for leguminous plants, C. NAUDIN (*Jour. Agr. Prat., 58 (1894), No. 39, pp. 453–455*).—A brief notice on species of plants which require soil inoculation, and on others in which such inoculation appears to be unnecessary.

Lentils in foreign countries (*U. S. Consular Rpt. 1894, Aug., pp. 505–530*).—A series of articles on the culture, uses, and statistics of lentils in Austria, British India, Chile, Egypt, France, Germany, Italy, Russia, and Great Britain.

Fertilizer experiments on meadows, C. A. GOESSMANN (*Massachusetts State Sta. Rpt. 1893, pp. 237, 238*).—Notes and tabulated data giving the yield of the plats to which either wood ashes, barnyard manure, or a mixture of ground bone and muriate of potash were applied.

Experiments with oats, M. A. SCOVELL and C. L. CURTIS (*Kentucky Sta. Rpt. 1891, pp. 97–99*).—A reprint of Bulletin 35 of the station (E. S. R., 3, p. 227).

Experiments with oats, M. A. SCOVELL (*Kentucky Sta. Rpt. 1892, pp. 119, 120*).—A reprint from Bulletin 42 of the station (E. S. R., 4, p. 342).

Potato experiments, M. A. SCOVELL (*Kentucky Sta. Rpt. 1891, pp. 102–112*).—A reprint of Bulletin 37 of the station (E. S. R., 3, p. 791).

Field experiments at the agricultural school of Carlsbourg, Belgium, in 1893, MATHIAS (*Bul. Min. Agr. Belgique, 10 (1894), No. 1, pp. 103–109*).—Fertilizer and variety tests of potatoes and tests of forage plants.

Rice growing and preparation for market, R. W. McCULLOCH (*Queensland Dept. of Agr. Bul. 2 (2d ser.), pp. 19, figs. 7*).—A popular article on nutritive value of rice; statistics, varieties, selection of seed and soil; directions for cultivating, harvesting, threshing, and hulling; and estimated profits in the culture and in the manufacture of rice.

Varieties of rye, F. VON LOCHOW (*Fühling's landw. Ztg., 43 (1894), No. 17, pp. 548–552*).—An account of the origin of a new variety, and tabulated statements of yields made by a number of varieties.

Sugar beet cultivation, J. MUTH (*U. S. Consular Rpt. 1894, Aug., pp. 617–621*).—A popular statement of the conditions required by the sugar beet as regards soil, climate, and exposure.

Sugar cane, J. P. D'ALBUQUERQUE and J. R. BOVELL (*Rept. Expt. Fields, Dodds Reformatory, Barbados, 1892*).—The experiments conducted were tests of fertilizers on sugar cane, variety tests, distance experiments, and experiments to determine the best part of the stalk for planting. Insect and fungus enemies of sugar cane were also investigated.

The chemical composition of sugar cane, H. WINTER (*West Java Sugar Sta. Contr. 1, pp. 26–39*).

Fertilizer experiments with sugar cane in Demerara, JENMAN and HARRISON (*Abs. in Sugar Cane, 1894, pp. 508–520*).

Concerning the manuring of sugar cane, H. C. P. GEERLIGS (*Repr. from Arch. Java Suikerind., 1893, pp. 31*).

Field experiments with sugar cane, H. WINTER (*West Java Sugar Sta. Contr. 1, pp. 20–25*).

Soil investigations for sugar cane (*East Java Expt. Sta. Contr. 49, pp. 41*).

Chlorin in soils suitable for sugar cane, T. L. PHIPSON (*Sugar Cane, 1894, pp. 526, 527*).

Degeneration of cane through the exclusive planting of tops, F. A. F. C. WENT (*West Java Sugar Sta. Contr. 11, pp. 1–14*).

What part of the cane shall be planted? J. G. KRAMERS (*East Java Expt. Sta. Contr. 47, pp. 60–62*).

What part of the cane shall be used in planting? J. D. KOBUS (*East Java Expt. Sta. Contr. 6, n. ser., pp. 18–21*).

Results obtained in 1892–'93 by planting various sorts of cane, J. D. KOBUS (*East Java Expt. Sta. Contr. 6, n. ser., pp. 17*).

Sugar cane seedlings for 1893, J. H. WAKKER (*East Java Expt. Sta. Contr. 5, n. ser., pp. 13*).

Concerning the reversion of saccharose in harvested cane, F. A. F. C. WENT and H. C. P. GEERLIGS (*West Java Sugar Sta. Contr. 11, pp. 14–18*).

Wheat-growing in Queensland, E. M. SHELTON (*Ann. Rpt. Dept. Agr. Queensland, 1892-'93, pp. 40, 42-62*).

Experiments with varieties of wheat, III and IV, J. DESPREZ (*Jour. Agr. Prat., 58 (1894), No. 37, pp. 398-401; No. 38, pp. 432-435*).—Notes and tabulated data regarding varieties grown in France.

Rieti wheat; results of crops of this variety grown in France in 1894, J. GENIN (*Jour. Agr. Prat., 58 (1894), No. 37, pp. 378, 379*).

Systems of drying grain or hay artificially (*Abs. in Braunschw. landw. Ztg., 62 (1894), No. 32, pp. 137-140*).—A historical résumé.

Experiments with wheat, M. A. SCOVELL and C. L. CURTIS (*Kentucky Sta. Rpt. 1891, pp. 87-97*).—A reprint of Bulletin 35 of the station (E. S. R., 3, p. 227).

Wheat experiments in 1892, M. A. SCOVELL (*Kentucky Sta. Rpt. 1892, pp. 108-119*).—A reprint from Bulletin 42 of the station (E. S. R., 4, p. 342).

Field experiments with fertilizers on corn, potatoes, and tobacco, M. A. SCOVELL (*Kentucky Sta. Rpt. 1893, pp. 59-70*).—A reprint of Bulletin 45 of the station (E. S. R., 4, p. 716).

Report of the agriculturist, W. W. COOKE (*Colorado Sta. Rpt. 1893, pp. 34-38*).—Brief statements concerning the work of the agricultural section of the station, with recommendations.

Report on farm work, C. A. GOESSMANN (*Massachusetts State Sta. Rpt. 1893, pp. 220, 226, 239, 240*).—Notes on rye, winter rape, corn, and artichokes, and a statement of the crops produced on the station farm in 1893.

Report of the Arkansas Valley Substation, F. A. HUNTLEY (*Colorado Sta. Rpt. 1893, pp. 61-71*).—The crops grown were wheat, oats, barley, rye, flax, sorghum, Kaffir corn, millet, soja beans, field peas, corn, alfalfa, *Bromus inermis*, redtop grass, Kentucky blue grass, timothy, white clover, esparcet, potatoes, sugar beets, cucumbers, and turnips. Most crops were greatly injured by a hailstorm occurring July 8. Rye sown at the rate of 4 pecks per acre gave a yield of 12 bu.; sown at the rate of 8 pecks the yield was 19 bu. Other subjects mentioned are the cost of growing alfalfa, transplanting of forest trees, the percentage of fat in the milk of 3 Jersey cows, and improvements made during the year.

Report of the Divide Substation, J. H. MCCLELLAND (*Colorado Sta. Rpt. 1893, pp. 58-60*).—Brief notes on varieties of wheat, deep and shallow plowing for oats, amount of seed for oats, and variety tests of potatoes. Other crops grown were flax, buckwheat, sweet corn, winter rye, field peas, alfalfa, English rye grass, orchard grass, canary grass, alsike clover, esparcet, red clover, white clover, timothy, yellow oat grass, tall meadow fescue grass, Italian rye grass, awnless brome grass, turnips, currants, and gooseberries.

Report of San Luis Valley Substation, F. BEACH (*Colorado Sta. Rpt. 1893, pp. 72-78*).—General statements concerning the work of the farm, a test of fertilizers on potatoes, a variety test of potatoes and of wheat, and an experiment to determine the best amount of oats to sow. Other crops grown were millet, sugar beets, beets, turnips, onions, lettuce, radishes, tomatoes, peas, and cabbages.

HORTICULTURE.

Field experiments with different mixtures of commercial fertilizers on several garden crops, C. A. GOESSMANN (*Massachusetts State Sta. Rpt. 1893, pp. 200-211*).—Six plats of land, 88 by 62 ft., were fertilized in 1891, 1892, and 1893 with sulphate of ammonia, nitrate of soda, dried blood, muriate of potash, sulphate of potash, and dissolved boneblack in different combinations. The proportions of each combination per acre were available phosphoric acid 50.4, nitrogen 60, and

potassium oxid 120 lbs. On each of these plats were grown beets, cabbage, celery, lettuce, spinach, tomatoes, and potatoes, the position of each vegetable in the plats being changed from year to year to introduce so far as practicable a system of rotation of crops, but the order of arrangement was the same on all the plats.

Tables are given showing the results for the several plats in the different years.

In 1893 plat 5, fertilized with 47 lbs. of nitrate of soda, 30 of sulphate of potash, and 40 of dissolved boneblack, gave the greatest yield of spinach, beets, celery, tomatoes, and lettuce. The result was the same in the 2 preceding years, except that then cabbages and potatoes also gave the best results on plat 5.

Special fertilization with reference to some prominent industrial crops, fruits, and vegetables, C. A. GOESSMANN (*Massachusetts State Sta. Rpt. 1893, pp. 241–261*).—To continue during the winter the field experiments mentioned above, 12 boxes of earth were placed in the vegetation house of the station and each fertilized with a different combination of the following substances: Muriate of potash, sulphate of potash, carbonate of potash and magnesia, phosphate of potash, dissolved boneblack, odorless phosphate, double superphosphate, nitrate of soda, sulphate of ammonia, phosphate of ammonia, and dried blood. The relative ratio of essential fertilizing constituents applied was 4 parts potassium oxid, 1 part phosphoric acid, and 1 part nitrogen. Each box was planted with seeds of lettuce, spinach, beets, and tomatoes.

From the tables given the lettuce appears to have made the best growth where the fertilizer contained carbonate of potash and magnesia, and the poorest where the nitrogen was furnished by ammonia salts. The beets gave much the same results. The spinach apparently showed a more vigorous growth when nitrate of soda was present. The experiment with tomatoes was less conclusive. All of the fertilized plants grew better than check plants grown on soil manured only with vegetable compost.

For garden vegetables and fruit trees a mixture containing 24 per cent potassium oxid, 12 per cent phosphoric acid, and 12 per cent nitrogen is suggested. A table is appended showing the relative proportions of these constituents in many fruits and garden crops.

Climate and its effects on the quality of apples, L. H. PAMMEL (*Trans. Iowa Hort. Soc., 27 (1892), pp. 132–138*).—A preliminary paper on the subject, giving the origin and cultivated range of the apple, and notes on the varieties Oldenburg, Fameuse, Wealthy, and Ben Davis. In spite of the fact that as a rule fruits improve in quality toward the equator, the data so far collected seem to indicate that most varieties of apples reach their perfection in a cooler climate.

Zinc in American dried apples, F. FILSINGER and R. HEFELMANN (*Chem. Ztg., 18 (1894), No. 65, pp. 1239, 1240; No. 69, pp. 1319,*

1320).—The first paper is a discussion of the alleged discovery by R. Hefelmann of zinc in dried apples imported to Germany from the United States. It is believed that the minute quantity claimed to have been found would not be injurious to the human system. The accuracy of the chemical analysis is questioned, more care is advocated, and a new method of analysis is suggested and technically described.

In the second article R. Hefelmann replies to the criticism by F. Filsinger, denying inaccuracy and careless methods. The method of analysis is detailed, and belief is reaffirmed in the danger of poisoning from the zinc in imported dried apples.

Cranberry culture, E. HERSEY (*Agriculture of Massachusetts, 1893, pp. 365–370*).—The writer believes that cranberries can be grown on many bogs now in a wild state. The water should be drawn off by ditches to from 6 to 12 in. below the surface, and a ditch should be dug across the upper end of the bog to further limit the water supply. A reservoir above the bog is recommended, the water from which can be let upon the bog during the winter and kept in by a dam across its lower end. If the bog is covered with grass the sod should be removed and all trees and bushes should be cleared away. From 4 to 6 in. of coarse clean sand or fine gravel is to be spread over the surface and the vines pressed into it, being placed 10 in. apart in 10-inch rows. For the first 2 years the bog should be weeded, after which the vines will usually keep out all weeds and grass. The water should be let upon the bog at the beginning of cold weather and kept there until May, when it should be gradually drained off. In Massachusetts the fruit is usually ripe enough for picking by the middle of September.

Strawberries, M. H. BECKWITH (*Delaware Sta. Bul. 24, pp. 10*).—Descriptive notes and tabulated data for 93 varieties of strawberries. In order to ascertain the best varieties for market use, the culture was of the kind ordinarily employed by growers in that section, and no especial fertilizing was given to the soil. Twelve plants of each variety were planted 2 ft. apart in 3½-ft. rows, and the runners allowed to mat for a year previous to the test. The following varieties are considered best for marketing: Bubach, Brandywine, Greenville, Harmon, Haverland, Michel Early, Mrs. Cleveland, Muskingum, Pearl, and Phillips.

The bulbous chervil, J. GEROME (*Rev. Hort., 66 (1894), No. 14, pp. 331–334, figs. 2*).—A popular article on *Chærophyllum bulbosum*, treating of its botanical relationships and food value, and giving full directions for its culture, recommending its wider cultivation.

Chicory, A. ROCHE (*Jour. Agr. Prat., 58 (1894), No. 41, pp. 534–543*).—A popular article on the culture of chicory.

A few salad plants, G. ALLUARD (*Rev. Hort., 66 (1894), No. 17, pp. 403, 404, figs. 4*).—A popular article describing and figuring the more favorite salad plants, such as cress, chicory, etc., with notes on their cultivation and preparation for food.

Truffles of Tunis and Tripoli, A. CHATIN (*Compt. Rend., 119 (1894), No. 11, pp. 485–487*).—Notes on reports from the French consuls in those countries. *Terfezia*

claveryi and *Helianthemum sessiliflorus* are found in Tunis, and *Terfezia boudieri* in Tripoli.

Experiments with vegetables, C. L. CURTIS (*Kentucky Sta. Rpt. 1892, pp. 20–34*).—A reprint from Bulletin 38 of the station (E. S. R. 3, p. 791).

Vegetables, C. L. CURTIS (*Kentucky Sta. Rpt. 1891, pp. 48–57*).—A reprint from Bulletin 32 of the station (E. S. R., 2, p. 641).

Field and garden crops of the Northwestern Provinces and Oudh, III, J. F. DUTHIE (*Dept. Land Records and Agr., Roorkee, India, 1893, pp. 65, pls. 36*).—The third and last part of a rather elaborate illustrated work upon the native and introduced economic plants grown in India. In most cases botanical descriptions and notes on culture and uses are given. This part treats chiefly of the garden plants, many of which are not cultivated elsewhere.

A new hotbed frame, S. MOTTET (*Rev. Hort., 66 (1894), No. 15, pp. 358, 359, fig. 1*).—Illustrated description of a new form of hotbed for early forcing, the new feature consisting of glass frames hinged at the middle, and both opening.

Cement benches for subirrigation in greenhouses, L. R. TAFT (*Amer. Agr. (middle ed.), 1894, Oct. 13, p. 189, fig. 1*).

The automatic sprinkling of gardens, G. D. HUET (*Rev. Hort., 66 (1894), No. 14, pp. 335–339, fig. 3*).—Concerning a system of irrigation by means of pipes and hose, with nozzles at intervals for spraying the plants.

Top grafting the apple, C. G. PATTEN (*Trans. Iowa Hort. Soc., 28 (1893), pp. 203–209*).—An article based on the answers to a circular letter sent to 60 fruit growers in Iowa and adjacent States. The general consensus appears to be that top grafting is rather preferable to root grafting, but on account of the influence often produced by the stock on the graft careful judgment must be used in selecting the stocks.

Peach culture in Belgium, N. SMITH (*U. S. Consular Rpt. 1894, Aug., pp. 636–639.*)—A popular account of the methods of training and protecting peach trees from frost.

Worn-out peach trees (*Garden, 46 (1894), No. 1193, pp. 301, 302*).—A popular article on the subject, advising the replacing of superannuated trees with thrifty younger ones and manuring the ground.

The thinning out of fruit, G. BELLAIR (*Rev. Hort., 66 (1894), No. 17, pp. 399–401, fig. 1*).—Thinning is advised to improve the size and flavor of the fruits remaining on the tree. Arguments in its favor are cited and an implement for thinning grapes is figured.

Orchard sites and varieties of tree fruits in Iowa, R. P. SPEER (*Trans. Iowa Hort. Soc., 28 (1893), pp. 129–134*).—A discussion of the texture and composition of some Iowa soils and their respective adaptability for fruit. Plenty of air and water drainage is advised for orchards, and several hardy varieties of fruits are named. The physiology of fruit trees is also treated.

Fruit growing, E. W. WOOD (*Agriculture of Massachusetts, 1893, pp. 161–172*).—A paper treating of the present status of fruit raising in New England, and urging the extension of the industry. The culture, enemies, and marketing of apples, pears, peaches, plums, cherries, quinces, strawberries, currants, raspberries, blackberries, and grapes are discussed, and the varieties best adapted for Massachusetts are mentioned.

Cold storage of fruit (*Jour. [British] Bd. Agr., 1 (1894), No. 1, pp. 5, 6*).—Abstract of a report of the Department of Agriculture and Forests of New South Wales. It was found that solid-fleshed fruits at a temperature of 41 to 43° F. would keep for 2 months, and that softer fruits would keep 2 weeks or more. Careful grading and packing of the fruits is necessary.

Barberries, II, F. L. SARGENT (*Pop. Sci. Monthly, 45 (1894), No. 6, pp. 784–795, figs. 20*).

The cultivated raspberries of the United States, A. A. CROZIER (*Michigan Sta. Bul. 111, pp. 74*).—An annotated catalogue giving the botanical origin, history, and

qualities of the varieties known to be grown in America. Four hundred and thirty-three names are given, of which 83 are synonyms. The following varieties are recommended for Michigan and adjacent regions: Blackcaps—Gregg, Nemaha, Palmer, Ohio, Hilborn, Kansas, and Conrath; purple caps—Shaffer and Columbia; red—Cuthbert, London, Turner, Thwack, Marlboro, and Hansell.

Experiments with strawberries, C. L. CURTIS (*Kentucky Sta. Rpt. 1892, pp. 34, 35*).—A reprint from Bulletin 38 of the station (E. S. R., 3, p. 791).

Strawberries, C. L. CURTIS (*Kentucky Sta. Rpt. 1891, pp. 41–47*).—A reprint from Bulletin 32 of the station (E. S. R., 2, p. 641).

Strawberries in August and September (*Garden, 46 (1894), No. 1193, p. 304*).—Notes on obtaining a second late crop from plants which had been fruited early by forcing. The plants were grown in rich, warm soil, and plentifully watered.

Old and new grape hybrids, G. FOËX (*Prog. Agr. et Vit., 11 (1894), No. 38, pp. 313–317*).

Grape-root grafts, DAUREL (*Prog. Agr. et Vit., 11 (1894), No. 38, pp. 317–323*).—An account of the experiments with American varieties of grapes as stocks repellant to the phylloxera. The Clinton, Taylor, and Herbemont are recommended as good stocks to graft upon.

Premature falling of grapes, G. H. POWELL (*Garden and Forest, 7 (1894), p. 397*).—The premature falling of grapes from the cluster is reported, which is thought to be due to faulty nutrition, although there is a possibility that it may be due to a specific disease as yet undiscovered.

The perfume of Magnolia glauca, G. BELLAIR (*Rev. Hort., 66 (1894), No. 15, pp. 347, 348, fig. 1*).—A comparison of the odor of the bloom of *Magnolia glauca* with that from other flowers, and a plea for the more general cultivation of the magnolias.

Training the stems of rose bushes, C. GROSDEMANGE (*Rev. Hort., 66 (1894), No. 16, pp. 370–374*).—Directions for training and pruning rose bushes for the best production of blossoms, with notes on the general culture on a large scale.

Adventitious buds of Kniphorfia (*Gard. Chron., 16 (1894), ser. 3, p. 437, fig. 1*).—Notes on buds from the flower stalk.

Horticultural "sports," C. T. DRURY (*Nat. Sci., 5 (1894), No. 32, pp. 265–268*).—Urges that odd and striking varieties are the result of sports, and cites the example of nectarines, which suddenly originated on an old peach tree that had for many years borne peaches. The tendency to reversion is great, especially at first.

Physalis francheti (*Gard. Chron., 16 (1894), ser. 3, p. 434, pl. 1*).—General and technical description of a new Japanese species of Bladder cherry, which is figured.

Improved chestnut culture (*Rural New Yorker, 53 (1894), No. 2334, pp. 661, 662*).—Notes on the employment of worked-out, waste, and stony land for chestnut groves. The variety Paragon is recommended.

Birds injuring apples, F. W. CARD (*Garden and Forest, 7 (1894), p. 414*).—Brief mention of birds attacking the fruit.

How to exhibit at agricultural fairs, L. R. TAFT (*Amer. Agr. (middle ed.), (1894), Sept. 1, p. 3*).—Applies to fruit exhibits.

FORESTRY.

The effect of thinning forests on tree growth, C. CLAUDOT (*Bul. Min. Agr. France, 13 (1894), No. 3, pp. 300–313*).—The third of a series of papers on investigations of the subject. Three tracts of land were chosen in 1882 for experimentation, in one of which the smaller trees and underbrush were cut away, in another the larger trees and underbrush were removed, and the third was left as a check. In all 3 the dead or dying timber was removed. The trees were mostly oak, with a scat-

tering of beech, and yoke-elm. In pursuance of the investigations, accurate censuses were taken in 1882, 1886, and 1893, and tables are given showing the statistics and results.

At the present stage of the investigations the trees in the tract where the larger trees were left appear to be growing most vigorously, and both of the tracts experimented upon show a greater growth than the check tract. The beeches show a rate of growth nearly double that of the other species.

The turpentine tree, J. H. MAIDEN (*Agl. Gaz. N. S. W., 5 (1894), No. 7, pp. 463–467, pl. 1*).—Botanical and economic notes on *Syncarpia laurifolia*, an Australian tree, the timber of which makes very durable posts and piles. The lasting quality is believed to be due to a brown oleo-resin contained in the wood, and which may prove of commercial importance. The timber is very hard to burn, and so recommended for building. The trees grow from 120 to 180 ft. high and 20 to 30 ft. in circumference on good soil, of which its presence is an indication. Its thick foliage makes it desirable for parks.

Notes on West American Coniferæ, J. G. LEMMON (*Erythea, 2 (1894), No. 10, pp. 157–162*).

Concerning the cultivation of pines in central Europe, J. SLAVICEK (*Forstw. Centbl., 20 (1894), pp. 355–368*).

Hybridity in willows, F. BECKWITH (*Proc. Rochester Acad. Sci., 2 (1894), No. 3, pp. 254–256*).

The thinning of forests, I and II (*Gard. Chron., 16 (1894), ser. 3, pp. 364–366, 401, 402*).

Prairie woodlands, E. J. HILL (*Garden and Forest, 7 (1894), No. 347, pp. 412, 413*).—A discussion of the character of the shrubby and woody growths found in moist localities in prairie regions.

Trees of Nebraska, C. E. BESSEY (*Ann. Rpt. Nebr. Bd. Agr., 1894, pp. 98–127; abs. in Garden and Forest, 7 (1894), p. 389*).

Biological investigations of the wooded valleys of Sweden, A. Y. GREVILLIUS (*Bot. Ztg., 52 (1894), No. 8 and 9, pt. 1, pp. 147–168*).

SEEDS—WEEDS.

Saving and care of seed, L. R. TAFT (*Amer. Agr. (middle ed.), 1894, Oct. 6, p. 159*).

The weight of a grain of wheat, J. U. LLOYD (*Amer. Jour. Pharm., 66 (1894), No. 10, pp. 473–479*).

Defective germination in wheat, E. SCHRIBAUX (*Prog. Agr. et Vit., 11 (1894), No. 40, pp. 377, 378; Jour. Agr. Prat., 58 (1894), No. 4, pp. 493, 494*).

The influence of fungicides upon the germination of seeds, L. H. PAMMEL and F. C. STEWART (*Agl. Sci., 8 (1894), No. 5, pp. 215–231*).—A résumé of the results secured by other investigators, and tabulated information of experiments by the authors with corn and oats.

Concerning the dissolution of the secondary cell membranes of seeds during germination, T. ELFERT (*Bibliotheca Botanica, 1894, No. 30, pp. 26*).

The Russian thistle, W. M. HAYS (*Minnesota Sta. Bul. 33, pp. 16, figs. 3*).—The author gives a popular description of the Russian thistle (*Salsoli kali tragus*), and suggests various methods by which it may be eradicated. The necessity of adequate weed laws and their enforcement is pointed out.

Methods of destroying weeds, WITTMACK (*Braunschw. landw. Ztg., 62 (1894), No. 36, pp. 153, 154*).

DISEASES OF PLANTS.

Preventing leaf blight of plum and cherry nursery stock (*New York State Sta. Bul. 72, n. ser., pp. 341–346, figs. 2*).—This is a continuation of the work reported by D. G. Fairchild in Bulletin 3 of the Division of Vegetable Pathology of this Department; in Journal of Mycology, 7, pp. 240–264; and in the Annual Report of the station for 1892, pp. 642–673 (E. S. R., 4, pp. 500, 954; 6, p. 60). During 1893 the experiments were continued on the treatment of plums and cherries which had been treated previously with Bordeaux mixture. The further treatment of those trees which had been treated with other fungicides was abandoned, as it was shown that their foliage was more or less injured by the fungicides.

The cherry stock consisted of Windsor, Yellow Spanish, and Montmorency on Mahaleb and Mazzard. They were practically free from the disease during 1893, and consequently no appreciable advantage was shown in the treated over the untreated trees.

Of the plums 3 varieties, Early Prolific, Purple Egg, and Italian Prune on Myrobolan and Marianna, were treated. Two treatments were given, one June 13 and the other July 14. The leaf blight was abundant among the plums. The sprayed trees, however, held their leaves about a month later and made a much better growth than did the unsprayed trees. The benefit of the treatment was seen not only in the more perfect foliage of the sprayed trees, but in their increased growth, as shown by the increased weight of top and roots, as well as the larger diameter of trunk.

The strength of Bordeaux mixture used in this work was 1 lb. of copper sulphate to 11 gal. of water, with the necessary amount of lime. Detailed directions are given as to the methods of preparation and application of the fungicide.

The author's summary is as follows:

"(1) In 1892 cherry nursery stock was successfully treated for the prevention of leaf blight. The same trees treated again in 1893 showed no benefit from the treatment, because both treated and untreated trees were practically free from the disease.

"(2) In 1892 plum nursery stock was successfully treated with Bordeaux mixture for leaf blight. The same trees were again successfully treated with the same mixture in 1893. The good effects of the treatment were shown in the increased growth of both tops and roots, and in the healthier foliage. The foliage remained attached to the braches about a month later than did the unsprayed foliage."

Some fungus diseases of plants and their treatment, H. H. LAMSON (*New Hampshire Sta. Bul. 19, pp. 13, fig. 1*).—The author popularly describes some of the more common diseases of fruit trees, such as scab and cracking of apples and pears, blight of pears, and black knot and rot of plums and cherries. Formulas are given for fungicides and directions for their application. A summary of experiments in spraying is given, in which it is shown that in 1892 a Fameuse

apple tree given 5 sprayings of Bordeaux mixture gave 89 per cent of first-class and 11 per cent of scabbed fruit, as compared with 77 per cent of first-class and 23 per cent of scabbed from check not sprayed. A Flemish Beauty pear tree was given 6 sprayings, and 98 per cent of the fruit was practically free from scab as compared with 17 per cent from the check tree. In 1893 experiments were conducted on Sheldon pear trees, to which 4 applications were given, and the fruit when gathered gave 88 per cent practically free from scab as compared with 38 per cent from the check. A Flemish Beauty pear tree was sprayed with 4 applications of Bordeaux mixture and gave 96 per cent of first-class fruit as compared with from 10 to 15 per cent for the unsprayed trees. Another Flemish Beauty tree given 4 applications of Bordeaux mixture of a much more dilute solution gave 63 per cent free from scab. A tree of Louise Bonne was sprayed with ammoniacal copper carbonate and gave 97 per cent of first quality fruit. All these experiments tended to show the advantage to be derived from the application of fungicides.

The pectic disease of grapes, C. SAUVAGEAU and J. PERRAUD (*Rev. Internat. Vit. et Œnol., 1 (1894), No. 7, pp. 241–250*).—During the past year there appeared in the vineyards of Beaujolais an apparently new and very destructive disease, to which the authors give the name "*maladie pectique.*" Its first appearance was noticed May 15, and it was soon afterwards reported from 10 or more adjacent communes. By some it is thought to be the same as rougeot, and while it does resemble that disease in its early stages, it soon becomes sufficiently distinct to be distinguished from it. The authors claim that nearly everything resulting in a reddish discoloration of the leaf, whether of a physiological nature or due to other causes, has been wrongly called rougeot. The pectic disease is of physiological origin, and while resembling rougeot at first, soon loses the marks of resemblance, and may be easily recognized. Rougeot attacks the leaves indiscriminately, while this disease is confined to the lower leaves. These leaves show scattered over their surfaces small discolored areas which gradually become wine red and spread irregularly, involving more or less of the leaf. The spots begin to form between the veins and by coalescence soon a somber red color covers a large part of the leaf. So far there is little difference in appearance on the leaves of the two diseases, but in the pectic disease the red border of the blade of the leaf takes on the color of a dead leaf, becomes wrinkled, and dries up. About this time the blade of the leaf falls from the petiole before it is entirely dead. The red color is to be found only in vines bearing red fruits; on the white-fruited vines the color assumed by the leaves is a yellowish one.

Ordinarily only about the 4 lower leaves of the shoots are attacked, sometimes only 3 and sometimes 5 or 6, but very rarely more than this last number. The middle and upper ones remain sound, and the vegetation is checked but not wholly stopped. The flowers and newly forming fruit are likewise subject to the disease, turning brown and

falling from their pedicles when attacked, and as in the case of the leaves, only the lower flowers and grapes are affected.

The disease is found on vineyards on light soils or in granite, slaty, or pebbly ones, in fact in any soil sensible to climatic changes. Those vineyards suffered most which were most affected by the extreme drought of 1893, which ended in April, 1894, by continual rains, causing a remarkable fall in the temperature of the air and soil, and resulting in a marked change in the vegetative condition of the vines. Recently vineyards on compact soil have been noticed that were considerably affected. The authors think the disease due to these meteorological conditions, and French stock seems most subject to its attacks.

The point of attack on the leaves seems to be at the union of the petiole and leaf blade. If sections be made through a petiole at the point of attack and examined there will be seen isolated cells, fragments of vessels, and crystals and raphides of oxalate of lime in abundance. Some of the cell walls are as thin as ordinary parenchyma; others are irregularly thickened, white, and glistening like collenchyma. They preserve their form, but their protoplasmic contents are changed and large vacuoles are abundant. The middle lamella, by which the cells should be united, is completely wanting, and a slight jar will cause the leaf blade to fall. It may be that in place of the cellulose of the middle lamella a pectate of lime is formed, and for this reason the name pectic disease is given. Practically the same conditions are to be found in the veins and other parts of the diseased leaves as just described for the petiole.

The same phenomena may be observed in the case of the fruit as in the leaves, and no parasite of any kind is ever associated with the disease. The disease is attributed to abnormal conditions under which the plants grew, and whatever tended to restore the normal nutrition of the vines checked the disease.

The perithecia of white rot of grapes, P. VIALA and L. RAVAZ (*Compt. Rend., 119 (1894), No. 8, pp. 443, 444*).—The pycnidial form of this fungus, known as *Coniothyrium diplodiella*, has been known since 1885, but the fruiting form was not known until it was discovered by the authors in 1893. By confining infested stems, peduncles, and branches and their attached organs in sterilized sand and controlling the atmosphere and moisture the perithecia can be obtained. They are spherical, 140 to 150μ in diameter; their envelope is multicellular, very black, with a large crateriform opening. The paraphyses are filiform, regular, white, rarely branching above, and usually longer than the asci. The asci are 56μ long by 8.5μ in diameter, with a thin pearly membrane. They are borne on a weak stalk one sixth their height. The spores are 3.75 by 15μ, 8 to each ascus, fusiform, slightly curved, hyaline, or slightly tinted with yellow when ripe. The spores show a number of partitions, often varying in the same ascus. They are double or may be four-celled walls, the middle always being the thickest.

Based on the variable partitions of the spores, their paraphyses and the contents of perithecia, the authors consider this a new genus, to which they give the name *Charrinia diplodiella*.

On the perithecia of Uncinula spiralis, P. VIALA (*Compt. Rend.*, *119* (*1894*), *No. 7*, *pp. 411–413*).—The author announced in 1887 the probable identity of *Oïdium tuckeri* of Europe and *Uncinula spiralis*, and the finding of the perithecia in 1892 and their abundance in 1893 has made it impossible to fully establish their identity. The abundant formation of perithecia was due, in his estimation, to the excessive heat followed by a very sudden fall in temperature. Several other mildews, as *Sphærotheca pannosa*, *S. epilobii*, *Erysiphe horridula*, *E. communis*, and *Uncinula adunca*, which hitherto had not fruited in France, or only very sparingly, produced an abundance of perithecia during the last year.

Attention is called to 2 parasites of the mildew. They are *Cincinnobolus cesatii* on the conidiophores and an undetermined bacterial disease of the perithecia. The bacteria are characterized as numerous, small, rod-shaped, colorless, twice as long as their diameter, slightly swollen at their extremities, and often containing a spore at or near each end.

Banana disease in Trinidad, J. H. HART (*Bot. Dept. Trinidad*, *Circular Note 10*).—During the past few years the cultivation of bananas and plantains has suffered a severe check, due to one or more fungus diseases. Specimens were submitted to G. Massee, of Kew, who determined the fungus as *Marasmius semiustus*. Whether any other fungus is concerned in the diseases can not be definitely stated at this time. Burning of all decayed material is the only remedy suggested.

Experiments in checking potato disease (*Jour.* [*British*] *Bd. Agr.*, *1* (*1894*), *No. 1*, *pp. 14–16*).—Experiments were conducted by the agricultural department of the Irish Land Commission during the summer and autumn of 1893 for the purpose of testing the value of the application of Bordeaux mixture as a preventive of disease. The experiments were arranged with the view of obtaining information on the following points, viz: (1) Should the potato plant be sprayed from above only, below only, or from both above and below? and (2) is it sufficient to thoroughly spray the plant once only, provided that the dressing be applied when the foliage is fully developed and immediately before the earliest period at which the disease may be expected in the locality? It was further decided to test the efficacy of a 2 per cent solution as compared with a $1\frac{1}{2}$ per cent solution. The experiments were all conducted upon the Champion variety, that being the one most commonly grown in Ireland. The first application of the fungicide was given the plants the latter part of June, the second a month later. The amount of dressing varied from 100 to 160 gal. per acre. At the end of September the plats were harvested, and while the untreated vines were all dead, those which had received spraying with

Bordeaux mixture were still green and succulent. Seventy-two plats in all were treated, 36 receiving a 2 per cent solution, the rest a 1½ per cent solution. The experiments were divided into 9 sets of 8 plats each.

A comparison of the results obtained on those plats similarly treated with respect to the method and frequency of application, but which varied with the per cent of copper sulphate contained in the mixture, indicates that the best results were obtained with the 2 per cent solution in 21 cases, and with the 1½ per cent mixture in 15 cases. The plats which gave the highest yield in each of the 9 sets in 6 instances had been sprayed with a 2 per cent solution and in 3 instances with a 1½ per cent solution. Comparing the results obtained in each set of the experiments by the different systems of application, and irrespective of the amount of copper used, it appeared that in 2 sets the plats giving the highest yield were sprayed once only from above and below, 1 from above only, and 6 from below only, the last 7 sets having received 2 applications. A comparison of the average returns per acre shows that the plats which were sprayed twice at intervals of about 4 weeks from above and below gave the best results. It would appear, tnere fore, that in the case of this variety of potatoes it is desirable to use a mixture containing 2 per cent copper sulphate and to apply the mixture at least twice. For those varieties which have a more tender foliage than the Champion a 1½ per cent solution will probably be more suitable. The average increase of sound potatoes on all the treated as compared with the untreated plats was at the rate of 104 bu. per acre. In the case of 6 out of 72 of the sprayed plats losses were experienced varying from 30 cts. to $7.50 per acre.

A further series of experiments were carried on at the Botanic Gardens of Glasnevin with a special view of ascertaining (1) whether any portion of the copper contained in the solution finds its way into the tissue of the foliage, and if so in what form, and (2) if the plant is rendered practically disease proof by the absorption of copper by the tissues of leaves, although all traces of the mixture may have been removed by the rain. The data obtained in these last experiments seem so unreliable that conclusive results can not be obtained, and the experiments are to be repeated.

Concerning the stimulus produced by treating potato plants with copper, B. FRANK and F. KRÜGER (*Ber. deut. bot. Ges.*, *12* (*1894*), *No. 1*, *pp. 8–11; abs. in Forsch. Geb. agr. Phys.*, *17* (*1894*), *No. 3 and 4, pp. 348, 349*).—The authors refer to Rumm's[1] experiments with Bordeaux mixture on grape leaves, showing that the copper solution had a positively beneficial effect upon the plant. In the case of the grape the demonstration is admitted, and the authors have undertaken to show the effect of copper on the potato. The *Phytophthora* was com-

[1] Ber. deut. bot. Ges., 10, No. 2, pp. 79–93; E. S. R., 4, p. 968.

pletely controlled by the application of a 2 per cent solution of Bordeaux mixture. The influence upon the plant is shown by the following points: (1) The structure of the leaf shows a slight increase in thickness and in strength; (2) the chlorophyll content was increased; (3) the transpiration was constantly greater than in the unsprayed plants; (4) the assimilation by the leaves was very much greater; (5) the duration of the leaves was greater in the case of the sprayed ones; and (6) the tuber production and the starch formation in the tuber were considerably increased.

The authors found that some kinds of potatoes are, through unfavorable conditions, sometimes injured by applications of Bordeaux mixture.

The question having been raised as to whether it was the lime or copper that was beneficial to the plant, the authors assert very positively that it is the copper, the lime having little or no influence upon the plant.

Sugar cane disease in Trinidad, J. H. HART (*Bot. Dept. Trinidad, Circular Note 11*).—During 1893 experiments were carried on to investigate the supposed necessity of the intervention of insects in spreading cane diseases. A healthy growing cane plant was infected with the microconidia of *Trichosphæria sacchari* by inserting some of the spores in broken places in the midrib of the leaf. The cane continued to grow apparently unaffected until it reached a height of about 6 ft., when it assumed an unhealthy appearance, and finally dried away, proving that the fungus is capable of destroying the cane without the aid of any insect agency. Specimens of the diseased cane were sent to Kew for examination, and the report made is as follows:

"The following phases in the life cycle of *Trichosphæria sacchari* are present in the cane:

"*Conidial condition.*—(1) *Melanconium* stage, (2) macroconidial stage, (3) *Colletotrichum* stage.

"*Ascigerous condition.*—In small quantity and accompanying it, perithecia formed of purple polygonal tissue and inclosing large brown 1-septate spores not produced in asci- or stylospores. These structures have also been observed united with the ascigerous form on canes sent from Barbados, and complete the usual sequence of phases in the life cycle of species allied to *Trichosphæria sacchari*."

Experiments with fungicides, L. H. PAMMEL (*Iowa Bul. 24, pp. 985–990*).

Synopsis.—The author reports on the use of fungicides for the prevention of oat and wheat rust, the treatment of spot disease of currants, and experiments in treating oats with different chemicals and hot water.

Spraying to prevent oat and wheat rust (pp. 985–987).—Experiments were conducted during the past season with Bordeaux mixture and ammoniacal copper carbonate for the prevention of the rust of wheat and oats. It was intended that applications should be made every 10 days, but owing to rains the average time between applications was less than 10 days.

The treatment with wheat began May 13 and with oats about a week later. Five applications of Bordeaux mixture were made to wheat, the last June 10; and on June 12 rust was noticed on the sprayed wheat. One other application was given after this. Six applications of Bordeaux mixture were made on the oats, beginning when the plants were 2 or 3 in. tall. Applications of ammoniacal copper carbonate were made at the same dates, and these did not injure the leaves in any respect. The application of the fungicides was discontinued owing to the prevalence of the rust, there being no appreciable difference between sprayed and checked plants.

The author concludes that other means than spraying with fungicides must be found for the prevention of rust, and experiments are being conducted along other lines.

A third season's experiment in treating spot disease of currants (pp. 987, 988).—The author has previously reported on the value of Bordeaux mixture for the prevention of spot disease of currants (E. S. R., 4, p. 169), and last year experiments were conducted with ammoniacal carbonate of copper to which molasses was added. Seven applications were made to both white and black currants, the treatment varying somewhat, due to the condition of the weather. The currants retained their leaves until the end of the season, showing but few affected leaves, and in the spring the treated plants looked much better than the checks These and the previous experiments with Bordeaux mixture show the practicability of their use in the prevention of currant-leaf diseases.

Experiments in treating oats with different chemicals and hot water (pp. 988–990).—Experiments were conducted by the author, assisted by F. C. Stewart, in treating oats before planting with ammoniacal copper carbonate, corrosive sublimate, iron sulphate, Bordeaux mixture, and hot water. Separate lots of seed were treated for 2 hours, and others for 24 hours, with all the fungicides except Bordeaux mixture. Oats were soaked in the Bordeaux mixture for 2 hours only. The hot-water treatment was continued for 12 minutes at a temperature of 52 to 54° C.

The seed was planted April 18, and tabular information is given showing relative height of the plants May 5 and July 11. The treatment shows that hot water, iron sulphate, and Bordeaux mixture hastened germination, the first 2 about equally. The greatest number of seeds germinating were those treated with Bordeaux mixture, which exceeded the check. In regard to height of plants on May 5, the iron sulphate ranks first, followed by Bordeaux mixture. As far as total growth is concerned, the hot water ranks first, followed by Bordeaux mixture and iron sulphate, the check being poorer than the Bordeaux mixture. In the case of ammoniacal copper carbonate and corrosive sublimate, when the seed was soaked for 24 hours, the plants were thinner and made a larger growth when once started.

The author concludes that Bordeaux mixture and iron sulphate are

not injurious to the plants; that corrosive sublimate and ammoniacal copper carbonate act injuriously, injuring the germination; and that hot water favors and hastens development.

Experiments with the hot-water method for the prevention of smut in spring grains, J. L. JENSEN (*Tidsskr. Landökon, 13 (1894), pp. 383–398*).—The experiments were undertaken at the request of the Royal Agricultural Society of Denmark, and were conducted under ordinary farm conditions. Plats were grown on 11 farms in different parts of Denmark, the size of the plats ranging from 85 to 170 sq. ft. Smutty barley and oats were distributed to the different farmers, the seed furnished having received the following treatment: One lot each of barley and oats untreated; one lot of barley soaked in cold water for 4 hours, allowed to stand for 6 hours, and then dipped about 30 times during 5 minutes in water of 123° F. (50.6° C.); one lot of oats dipped during 5 minutes about 30 times in water of 129° F. (53.9° C.) (method A); one lot of oats treated as the preceding lot after 5 minutes' soaking in cold water and subsequent standing for some hours (method B). Five plats were thus sown to barley or oats at each farm taking part in the experiments.

Influence on the appearance of the smut.—The treated barley seed gave in all 3 smutty heads, against 66 heads in case of the untreated seed. In the oats 2,706 smutty heads were found in all in the untreated seed, 471 in that treated by method A, and 2 in that treated by method B. The treatment given in method A reduced the smut about four fifths. In earlier experiments conducted in a similar manner this treatment produced practically smut-free oats. In 1891 the following results were obtained on 3 different farms, 4 plats having been grown of each kind of seed at each place:

Number of smutty heads of oats from treated and untreated seed.

Locality.	Untreated.	Treated by method A.
Näsgaard	1,273	3
Lyngby	326	1
Dalum	796	7

The explanation of the difference in results obtained during 1893 and previous years is that the smut appearing in all earlier experiments was the open-oat smut, while that occurring in the experiments of 1893 was hidden smut.[1]

The author was in 1893 able to prove that the hidden form of oat smut is a distinct species. Two varieties of oats were used for the experiment, Danish White oats and Jutland Gray oats. Sixty grams were treated according to the hot-water method, *i. e.*, softened for 4 hours, left standing moist for 8 hours, and then submerged in water of 131° F.

[1] Kans. Sta. Bul. No. 15; abs. in E. S. R., vol. II, p. 638.

(55° C.) for 5 minutes. Half the quantity of each variety was sowed after this treatment, the other half was in both cases thoroughly infected with spores from a head of oats with smut perfectly hidden by the outer glumes. The 4 portions were sown on plats of about 18 sq. ft. The results obtained were as follows:

Smut in infected and non-infected oats.

Variety.	Headed straws.	Straws with smutty heads.
Gray oats, treated	812	....
Gray oats, treated and then infected	683	74
White oats, treated	332	....
White oats, treated and then infected	285	7

Only hidden smut appeared in the infected heads.

Influence on the yield of barley and oats.—The yields of barley from the 11 substations were pronounced the same for both kinds of seed in 6 cases, and largest for the treated seed in 5 cases. The oats showed similar yields in 4 cases and larger yields in 7 cases. Where a large number of plat experiments has been conducted the treated seed has, however, in the author's experience, always given the largest yields. The barley and oats grown were threshed and weighed separately at 4 substations, and the increase in yield amounted to 14.4 per cent in case of barley and 10 per cent in case of oats. In the experiment made by the author the increase amounted to 3.5 per cent (barley), 26.8 per cent (oats, method A), and 25.7 per cent (oats, method B), respectively; and the straw at the same time increased in yield 1.7 per cent, 2.3 per cent, and 10.2 per cent, respectively.

It was found that with the treated seed 9 (method B) and 10 (method A) per cent more headed oat straws were formed. "The reason is doubtless not that the treated seed has a higher power of germination, for a large number of comparative experiments have shown that the power of germination remains the same after the hot-water treatment, but that the germinative energy is increased, and the chances that all seeds capable of germination will germinate in the right time and come through the soil are greater for the treated seed."

From 2 to 4 per cent more plants will, as a rule, be obtained in case of treated seed, with 5 to 7 per cent more straw. The kernels from the treated seed weighed on an average 2.3 per cent more than those grown from untreated seed. In more than 70 different experiments with barley and oats no exception to this rule has been found.

The increase in yield obtained from the hot-water method is usually somewhat higher for oats than for barley. In the author's experience the increase for the latter lies between 6 and 10 per cent, while for oats it amounts to 8 to 12 per cent, and often more.—F. W. WOLL.

Botrytis disease, with critical notes on some species, C. WEHMER (*Ztschr. Pflanzenkrank., 4 (1894), pp. 204–210, fig. 1*).

Recent investigations on Botrytis cinerea (*Weinbau u. Weinhandel., 1894, No. 25, pp. 306, 307*).

Notes on Erysipheæ, A. D. SELBY (*Ann. Rpt. Ohio Acad. Sci., 2 (1894), pp. 36, 37*).

Morphology and anatomy of sprouts and leaves deformed by Exoasceæ, W. G. SMITH (*Forstl. naturw. Ztschr., 3 (1894), No. 10, pp. 420–427*).

Pestalozzina soraueriana, a new disease of meadow foxtail, P. SORAUER (*Ztschr. Pflanzenkrank., 4 (1894), No. 4, pp. 213–215*).—Report of attack upon *Alopecurus pratensis* by this fungus, with descriptions of the fungus and its effect upon its host.

Recent investigations on grain rusts, J. ERIKSSON and E. HENNING (*Ztschr. Pflanzenkrank., 4 (1894), No. 4, pp. 197–203*).—The life history is given of *Puccinia glumarum*, parasitic on grains and grass.

Sclerotinia heteroica, M. WORONIN (*Ber. deut. bot. Ges., 12 (1894), No. 7, pp. 187, 188*).—Short note on occurrence, host, and affinities of the above.

Three new species of Sphæriaceæ, L. GÉNAU DE LAMARLIÈRE (*Rev. gen. Bot., 6 (1894), pp. 321–323, figs. 3*).—Figures and descriptions are given of *Massarinula quercina* on *Quercus pedunculata*, *Pleospora luciæ* on *Sarothamnus scoparius*, and *Septoria bupleurina* on *Bupleurum longifolium*.

A parasitic disease of arrowroot and other plants, J. H. WAKKER (*East Java Expt. Sta. Contr. 2, n. ser., pp. 6*).

On cane diseases, P. BONAME (*Rev. Agr. Île Maurice, 8 (1894), No. 8, pp 178–187*).

The diseases of canes, C. A. BARBER (*Suppl. Leeward Islands Gaz., 1894, Jan. 25, pp. 114–122, pl. 1*).—Compiled information on the more common diseases of sugar cane.

Concerning the diseases and enemies of sugar cane, W. KRÜGER (*West Java Sugar Sta. Contr. 1, pp. 50–179, pls. 11*).

Red smut of cane, F. A. F. C. WENT (*Repr. from Arch. Java Suikerind., 1893, pp. 18, pls. 2*).

Cane disease due to Hypocrea sacchari, F. A. F. C. WENT (*Repr. from Arch. Java Suikerind., 1893, pp. 48, pl. 1*).

Sugar cane disease or black rot due to Phielaviopsis ethaceticus, F. A. F. C. WENT (*Repr. from Arch. Java Suikerind., 1893, pp. 8, pl. 1*).

Black rot of sugar cane in East Java, J. H. WAKKER (*East Java Expt. Sta. Contr. 7, n. ser., pp. 6, pl. 1*).

Report on fungus diseases of sugar cane (*Bot. Sta. Barbados Misc. Bul. 4*).—Compiled information on various cane diseases.

Chrysanthemum leaf spot, B. D. HALSTED (*Amer. Florist, 10 (1894), No. 333, p. 263, fig. 1*).—Brief note on a *Septoria* species unidentified.

A bacterial disease of grapes in Var, PRILLIEUX and DELACROIX (*Bul. Soc. Bot. France, 41 (1894), No. 5, pp. 384, 385*).—This disease is probably identical with "malnero" of Italy.

A disease of hops probably due to a nematode, J. PERCIVAL (*Abs. in Nat. Sci., 5 (1894), No. 31, pp. 170, 171*).—Report of a nematode disease of hops in Kent, probably due to *Tylenchus devastatrix* in the roots.

Diseases of mushrooms caused by parasitic fungi, J. COSTANTIN and L. MATRUCHOT (*Rev. gen. Bot., 6 (1894), No. 67, pp. 289–300, pl. 1*).—Report of a study of *Myceliophthora lutea* and *Monilia fimicola*.

Phoma sanguinolenta on parsnip, E. ROSTRUP (*Ztschr. Pflanzenkrank., 4 (1894), No. 4, pp. 195, 196, pl. 1*).

A pear fruit decay, anthracnose, B. D. HALSTED (*Amer. Gard., 15 (1894), p. 387*).

An experiment on plum rot, H. GARMAN (*Kentucky Sta. Rpt. 1893, pp. 130, 131, fig. 1*).—A reprint from Bulletin 47 of the station (E. S. R., 5, p. 876).

Leaf diseases of pine in the Saxony forests, F. NOBBE (*Tharand. Forst. Jahrbuch, 43 (1894), pp. 39–55*).—A description is given of a disease of the pine leaf caused by *Hypoderma macrosporum.*

A disease of pinks, L. MANGIN (*Rev. Hort., 66 (1894), No. 17, pp. 410–412*).—Pinks attacked by *Heterosporium echinulatum.* Copper sulphate and other sprays are advised.

Concerning a remarkable appearance of fungi on shade trees, causing their destruction, C. WEHMER (*Jahrsber. naturhist. Ges., 1891–'93, pp. 37–61, pl. 1*).

Progress in the study of the fungus of wheat scab, A. D. SELBY (*Ann. Rpt. Ohio Acad. Sci., 2 (1894), pp. 33, 34*).

Some fungus diseases of wheat and rye, FRANK (*Mitt. deut. landw. Ges., 1894, No. 6, pp. 90, 91*).—Descriptions and notes are given of *Leptosphæria herpotrichoides* and *Ophiobolus herpotrichus.*

A Septoria disease of cultivated veronicas, P. HENNINGS (*Ztschr. Pflanzenkrank., 4 (1894), No. 4, pp. 203, 204*).

Experiments in combating sugar cane diseases, F. A. F. C. WENT (*Repr. from Arch. Java Suikerind., 1893, p. 8*).

Remedies for cane diseases, C. A. BARBER (*Suppl. Leeward Islands Gaz., 1894, Feb. 24, pp. 127–131*).—Popular information on the best means for combating fungus and insect attacks.

The copper content of soil and cane and its relation to disease (*East Java Expt. Sta. Contr. 49, pp. 42–50*).

Treatment of chlorosis by applying sulphate of iron in autumn, P. DEGRULLY (*Prog. Agr. et Vit., 11 (1894), No. 39, pp. 335–338*).

ENTOMOLOGY.

Reports of observations and experiments in the practical work of the Division of Entomology (*U. S. Dept. Agr., Division of Entomology Bul. 32, pp. 59*).—This bulletin comprises the reports of the field agents for 1893.

Report on injurious insects in Nebraska and adjoining districts, L. Bruner (pp. 9–21).—The main portion of this report is in regard to locusts, which in 1892 and 1893 caused serious damages to crops in several localities, but are now apparently checked. The vicinity of Grand Junction, Colorado, suffered most, and the remedial methods employed are detailed. Notes are also given on the army worm (*Leucania unipuncta*), the wheat-head army worm (*L. albilinea*), the fall webworm, the eight-spotted forester, the stalk borer (*Gortyna nitela*), *Tanymecus confertus*, juniper-bark borer (*Phlæosenus dentatus*), *Lyda* sp., cucumber-plant louse (*Aphis cucumeris*), pine scale insects, and the chinch bug infection. Especial note is made of the beetle *Tanymecus confertus* as a sugar beet enemy.

Report on some of the injurious insects of California, D. W. Coquillett (pp. 22–32).—This is chiefly in regard to several kinds of leaf-eating caterpillars which attack various fruit and nut trees in the State. The walnut spanworms (*Boarmia plumogeraria* and *Prochærodes nubilata*) are given especial mention, and smearing the trunks of the trees with some sticky substance to prevent the ascending of the wingless females of the former species, and spraying with Paris green to kill the cater-

pillars of the latter are advised. The orange-leaf roller (*Tortrix citrana*) brassy cutworm (*Tæniocampa rufula*), corn-ear worm (*Heliothis armigera*), and tent caterpillars (*Clisiocampa thoracica*, *C. californica*, and *C. constricta*) are also treated. Experiments were made with arseniureted and sulphureted hydrogen to learn their value as insecticides, but they proved more expensive and less efficacious than hydrocyanic acid gas.

Report on entomological work in Oregon and California; notes on Australian importations, A. Koebele (pp. 33–36).—Some notes are given on the hop louse (*Phorodon humuli*) and on several species of Coccinellidæ that prey upon it. The ladybird *Rhizobius ventralis*, recently imported from Australia, is being naturalized and is destroying *Lecanium oleæ* and *L. hesperidum*. *Syneta albida*, *Carpocapsa pomonella*, and a Tortricid larva were found injuring fruit in Oregon.

Notes on the insects of Missouri for 1893, M. E. Murtfeldt (pp. 37–45).—This treats of the army worm (*Leucania unipuncta*), several locusts, leaf hoppers (*Ormenis pruinosa*), osage orange pyralid (*Loxostege maclurœ*), horn fly, fruit-bark beetle (*Scolytus rugulosus*), the pear-tree clear-wing borer (*Ægeria pyri*) attacking apple trees, the peach or plum bark louse (*Lecanium persicæ*), the linden-leaf roller (*Pantographa linata*), and the trial of combined insecticides and fungicides. There was an outbreak of the *Lecanium persicæ*, of which description and life history are given, and kerosene emulsion and like insecticides advised as remedies. *Pantographa linata* is also noted rather fully.

Insects of the season in Iowa in 1893, H. Osborn (pp. 46–52).—Several species usually inconspicuous were seriously abundant. Notes are given on the horse botfly, horn fly (*Hæmatobia serrata*), clover-hay worms (*Pyralis costalis* and *P. farinalis*), clover-seed caterpillar (*Grapholitha interstinctana*), sod webworm (*Crambus exsiccatus*), wheat-head army worm (*Leucania albilinea*), leaf folder (*Teras minuta*), leaf skeletonizer (*Pempelia hammondi*), *Nomophila noctuella*, and clover-seed midge (*Cecidomyia leguminicola*). Experiments were made upon eggs of the horse botfly, and it is concluded that they hatch only by the assistance of the horse's tongue, and that the period for hatching is from 12 to 40 days after their deposition. Scraping off the eggs or their destruction by means of washes is advised.

Report on insects injurious to forest trees, A. S. Packard (pp. 53–59).—There appeared to be a remarkable dearth of insects attacking forest foliage, but notes are given on the spruce worm (*Tortrix fumiferana*), larch worm (*Nematus erichsonii*), fir leaf-sheaf worm (*Blastobasis chalcofrontella*), fourteen-flapped geometrid and several lepidoptera bred from larvæ, on forest trees. Many forests in Maine that suffered in 1878–'87 from the spruce worm and larch worm are rapidly recovering and putting out new growth.

A very complete index accompanies the report.

The codling moth and apple rot, C. W. MATHEWS (*Kentucky Sta. Rpt. 1893, pp. 54–59*).—A discussion of the occurrence together of insect and fungus injuries to apples. As the moths seemed to choose the most perfect apples on which to deposit their eggs, those trees that had been sprayed with Bordeaux mixture against the rot suffered most. The most damage was done by a second summer brood of the moths. As a remedy, spraying with Paris green about July 1 is advised.

Corn insects, H. OSBORN (*Iowa Sta. Bul. 24, pp. 991–1005, figs. 13*).—A popular bulletin, more or less compiled, on the chief insects that affect maize while it is growing and after it is harvested. For the insects that work under ground in general is recommended early fall plowing of the land which it is intended to plant the next year in corn. The insects that work above ground must be combated according to the local conditions and the damaging species. Bisulphid of carbon is advised against insects affecting stored grain.

Description, life history, and treatment are given for the following species: Corn-root louse (*Aphis maidi-radicis*), corn-root worm (*Diabrotica longicornis*), corn billbugs (*Sphenophorus ochreus, S. parvulus*, and *S. sculptilis*), wireworm (*Melanotus communis*), sodworm (*Crambus interminellus*), cutworms (*Hadena devastatrix*, and *Agrotis subgothica*), stalk borer (*Gortyna nitela*), chinch bug, corn-leaf plant louse (*Aphis maidis*), corn worm (*Heliothis armigera*), and Angoumois grain moth (*Gelechia cerealella*).

Report on the extermination of the Gypsy moth (*Agriculture of Massachusetts, 1893, pp. 262–302, pls. 6, map 1*).—A report on the work of the Gypsy Moth Commission during the year 1893, with a résumé of the work done since 1889 and a plan of the work for 1894. The moth has been exterminated in all but 18 townships, as against 30 in which it was abundant in 1891. The means of dealing with the moth that has proved most effective is placing bands of burlap about the infested trees and those near by, under which the caterpillars crawl for concealment. The trees are examined every few days and the eggs, caterpillars, and pupæ are destroyed. The insecticide that proved to be the most satisfactory is a patent substance called gypsine, which did not injure the foliage, even when used in so large a proportion as 25 lbs. to 150 gal. of water, and was very destructive to the caterpillars.

In 1893 there were inspected 4,108,494 trees, of which 44,716 were found to be infested by the pest. Buildings, wooden fences, and stone walls were also inspected and cleared. It is estimated that 1,173,351 caterpillars, 77,029 pupæ, 5,655 moths, and over 50,000 egg clusters were destroyed during the year. The number of men employed in the work varied throughout the year, the largest number being over 150 during part of July. Many caterpillars in undergrowth on the borders of woodlands were destroyed by burning the tracts with crude oil. An insect lime was also used in banding trees to prevent caterpillars from climbing them, but it did not prove as effective as the year before.

Many male moths were attracted and captured by placing in the fields traps containing artificially reared female moths.

A map is given showing the tract now infested by the moth. It is believed that by continued action the practical extermination of the moth will be finally accomplished.

Important insecticides, C. L. MARLATT (*U. S. Dept. Agr., Farmers' Bul. 19, pp. 20*).—Directions for the preparation and intelligent application of remedies for insect injuries. For the purpose of classifying the insecticides, insects are divided into several groups, based upon their feeding habits, and thus differing more or less in remedial treatment. These are (1) external feeders, comprising (*a*) biting insects, and (*b*) sucking insects; (2) internal feeders; (3) subterranean insects; (4) insects affecting stored products; (5) household pests; and (6) animal parasites. Of these the external biters are to be combated by poisoning their food, which is best done by the application of the arsenicals, Paris green, London purple, and arsenate of lead, usually by spraying, but sometimes by dusting on the dry powder. The external suckers must be treated by the contact method, and either sprayed with the kerosene emulsions or resin washes, or fumigated with hydrocyanic acid gas. For subterranean insects are recommended kerosene emulsion, resin wash, potash fertilizers, bisulphid of carbon, and submersion by flooding the infected tract with water, as in the case of the phylloxera in France. Bisulphid of carbon is advised for grain infested by insects. Formulas and detailed instructions are given in each instance. The control of insects by cultural methods and clean farming is briefly treated, and some statistics given of the profits accruing from the use of remedial measures.

The presence of arsenic in sprayed tobacco, A. M. PETER (*Kentucky Sta. Rpt. 1893, pp. 14, 15*).—To ascertain if tobacco plants which had been sprayed with Paris green retained any of the poison when marketed, 3 samples of leaf tobacco were analyzed, and appreciable quantities of both copper and arsenic were found. Owing to the great importance of the matter, the investigations are to be continued.

Silkworms and how to rear them, R. W. MCCULLOCH (*Ann. Rpt. Dept. Agr. Queensland, 1892–'93, pp. 65–85, pls. 19*).—Popular directions on the above subject.

Injurious insects, C. P. GILLETTE (*Colorado Sta. Rpt. 1893, pp. 51–55.*)—Short notes on the ravages, life history, and treatment of the red-legged locust (*Melanoplus femur-rubrum*), two-lined locust (*M. bivittatus*), differential locust (*M. differentialis*), codling moth, leaf rollers (*Cacœcia argyrospila* and *C. semiferana*), garden webworm (*Loxostege cereralis?*), army worm (*Leucania unipuncta*), corn worm (*Heliothis armigera*), cutworms, woolly aphis (*Schizoneura lanigera*), onion thrips (*Thrips striatus?*), and potato-scab worm; and brief mention of the two-striped flea beetle (*Systena tæniata*), black flea beetle (*Phyllotreta pusilla*), bee moth (*Galleria mellonella*), wax or pollen moths (*Plodia interpunctella* and *Ephestia* sp.), eight-spotted forester (*Alypia octo-maculata*), buffalo tree-hopper (*Ceresa bubalus*), red spider, and several species of plant lice.

Some common pests of the farm and garden, H. GARMAN (*Kentucky Sta. Rpt. 1892, pp. 43–88*).—A reprint of Bulletin 40 of the station (E. S. R., 3, p. 792).

The orthoptera of Kentucky, H. GARMAN (*Kentucky Sta. Rpt. 1893, pp. 23–30*).—An annotated catalogue of the *Orthoptera* of the State, with some remarks on their distribution. Seventy species are enumerated.

Some injurious grape insects (*Canadian Hort., 17 (1894), No. 10. pp. 360, 361, fig. 1*).—Notes on insect attacks of grapevines, with especial mention of the leaf-hopper (*Typhlocyba vitis*) and the grape-berry moth (*Eudemis botrana*).

Insects affecting grapes, H. OSBORN (*Trans. Iowa Hort. Soc., 28 (1893), pp. 262–264*).—A popular article, giving descriptions, life histories, and remedies for the grapevine flea beetle (*Haltica chalybea*), grapevine leaf hopper (*Typhlocyba vitis*), phylloxera (*Phylloxera vastatrix*), eight-spotted forester (*Alypia octo-maculata*) and grape-berry moth or grape-seed caterpillar (*Eudemis botrana*).

The Diptera injurious to cereals observed at the entomological station of Paris, 1894, P. MARCHAL (*Compt. Rend., 119 (1894), No. 11, pp. 496–499*).—Notes on *Cecidomyia destructor*, *C. tritici*, *Oscinis pusilla*, *Chlorops* sp., *Camarota flavitarsis*, and *Elechipterox cornuta*.

On the life history of Cecidomyia pini, R. CHOLODKOWSKY (*Forstl. naturw. Ztschr., 3 (1894), No. 9, p. 380*).

Biology of Tomicus proximus, G. HENSCHEL (*Forstl. naturw. Ztschr., 3 (1894), No. 9, pp. 380, 381*).—Notes on this beetle, especially in reference to forestry.

A species of moth destructive to red cedar, A. S. OLLIFF (*Agl. Gaz. N. S. W., 5 (1894), No. 7, pp. 513–515, pl. 1*).—Descriptive and life history notes on a new species of moth, *Epicrocis terebrans*, the larvæ of which bore in the twigs of red cedar and seriously injure the growth of the trees.

Fruit and forest tree insects, H. OSBORN (*Trans. Iowa Hort. Soc., 27 (1892), pp. 96–127, figs. 33*).—A popular descriptive paper giving notes on about 60 of the more prominent injurious insects of the State, with figures of many, and remedies against ravages. The following species seem to be considered worthy of rather more attention than the others: Ash sawfly (*Monophadnus bardus*), strawberry slug (*Monostegia ignota*), fall webworm (*Hyphantria cunea*), white-marked tussock moth (*Orgyia leucostigma*), leaf crumpler (*Phycis indiginella*), codling moth (*Carpocapsa pomonella*), apple maggot (*Trypeta pomonella*), seventeen-year locust (*Cicada septendecim*), cherry aphis (*Myzus cerasi*), and woolly aphis (*Schizoneura lanigera*). An artificial key, based on the habits and occurrence, as well as appearance, is given, including many of the insects noted. General directions for spraying and using insecticides are added.

The pests of shade and ornamental trees, H. GARMAN (*Kentucky Sta. Rpt. 1893, pp. 88–129, figs. 14*).—A reprint of Bulletin 47 of the station (E. S. R., 5, p. 884).

The dahlia-stalk borer, E. J. HILL (*Garden and Forest, 7 (1894), p. 388*).—The author gives a brief account of the attack of *Gortyna nitela* on dahlias, and reports the same insect as attacking tomatoes.

Trapping wasps, A. DUBOIS (*Rev. Hort., 66 (1894), No. 16, pp. 385, 386, fig. 1*).—Description of a device for protecting ripening fruit by destroying the wasps of such species as have underground nests, a trap being placed over the entrance, into which the insects enter. They are afterwards smothered by the fumes of burning sulphur

Studies on bark beetles, A. PAULY (*Forstl. naturw. Ztschr., 3 (1894), No. 9, pp. 376–379*).—Notes on the life histories and ravages of several species.

The currant-bud mite (*Gard. Chron., 16 (1894), ser. 3, p. 293*).—Summary of a paper by R. Newstead on the life history, occurrence, and remedies to be employed against this insect.

Notes on Cheimatobia brunnata (*Jour. Agr. Prat., 58 (1894), No. 32, pp. 193–198 figs. 4*).

Injurious insects and fungi (*Jour. [British] Bd. Agr., 1 (1894), No. 1, pp. 43–61, figs. 2*).—Notes on the life history and treatment of several injurious insects, and on a few fungus diseases that caused damage in the United Kingdom in 1892 and 1893. A potato disease, the bean aphis, mangel fly, pear and apple scab, diamond bark

moth, nut mite, daddy long legs, larch disease, turnip and cabbage aphis, wire-worms, turnip fly, surface caterpillars, a new potato disease, and the antler moth are mentioned.

Means for the destruction of insects injurious to cane, and especially the white louse, F. A. F. C. WENT (*West Java Sugar Sta. Contr. 11, pp. 18-20*).—Recommends a pyrethrum extract made with a mixture of alcohol and ammonia water.

Concerning the parasites of the insect enemies of sugar cane, J. D. KOBUS (*East Java Expt. Sta. Contr. 8, n. ser., pp. 9, figs. 5*).—Notes on the bacterial, fungus, and insect enemies of sugar-cane insects, with something of the life histories. The wings of some of the *Hymenoptera* are figured.

The destruction of grubs by Botrytis tenella, J. H. WAKKER (*East Java Expt. Sta. Contr. 10, n. ser., pp. 7*).—A review of the European experiments. They have not been so successful in Java.

Remedies for cutworms (*Deut. landw. Presse, 21 (1894), No. 58, p. 570, figs. 3*).—Note on *Agrotis segetum*. Lights in the field are advised to attract and destroy the adult moths.

Bordeaux mixture for apple pests, H. GARMAN (*Kentucky Sta. Rpt. 1893, pp. 32–54, figs. 2*).—Reprint from Bulletin 44 of the station (E. S. R., 4, p. 659).

Analyses of insecticides (*Massachusetts State Sta. Rpt. 1893, p. 324*).—Analyses of 2 patented articles, *i. e.*, Oriental fertilizer and bug-destroyer, and Non-poisonous bug-destroyer, are reported.

FOODS—ANIMAL PRODUCTION.

Digestion experiments with sheep, J. B. LINDSEY (*Massachusetts State Sta. Rpt. 1893, pp. 146–178, pl. 1*).—Digestion experiments are reported on 2 samples of hay of mixed grasses, Buffalo gluten feed, old and new-process linseed meal, dried brewers' grains, corncobs, bran of spring and winter wheat, and wheat middlings, 4 sheep being used. The trial with each feeding stuff lasted 14 days, the excreta being collected for analysis the last 7 days. Hay of mixed grasses was fed with each of the commercial feeding stuffs. The complete data for the experiments are tabulated, including analyses of the feeding stuffs used.

A summary of the results is given below:

Coefficients of digestibility with sheep.

	Dry matter.	Crude cellulose.	Crude fat.	Crude protein.	Nitrogen-free extract.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Hay of mixed grasses (*a*):					
Sheep 2	60.67	62.08	57.04	63.31	63.46
Sheep 3	62.00	65.86	47.15	63.39	63.37
Sheep 4	61.43	64.73	50.09	63.76	63.14
Average	61.37	64.46	51.43	63.49	63.32
Hay of mixed grasses (*b*):					
Sheep 1	55.84	57.30	45.65	58.05	58.16
Sheep 2	55.10	55.90	47.22	58.13	56.80
Sheep 3	55.56	57.38	47.47	56.08	58.24
Sheep 4	55.86	57.98	47.26	57.04	58.19
Average	55.57	57.14	46.90	57.32	57.85
Buffalo gluten feed:					
Sheep 2	75.53	39.92	82.25	85.97	78.44
Sheep 4	80.44	46.28	80.58	83.94	84.37
Average	77.98	43.10	81.41	84.95	81.40
New-process linseed meal:					
Sheep 2	79.86	49.24	90.50	86.32	86.31
Sheep 3	82.60	73.21	91.52	88.16	84.71
Average	81.23	61.23	91.01	87.24	85.51

Coefficients of digestibility with sheep—Continued.

	Dry matter.	Crude cellulose.	Crude fat.	Crude protein.	Nitrogen-free extract.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Old-process linseed meal:					
Sheep 2	75.48	37.80	92.01	86.38	78.33
Sheep 3	82.25	71.47	85.30	93.36	78.73
Sheep 4	78.24	61.79	88.45	86.64	75.58
Average	78.66	57.02	88.59	88.79	77.55
Corncobs:					
Sheep 1	60.43	64.50	56.00	21.88	60.37
Sheep 2	58.51	66.16	44.22	12.87	59.71
Average	59.47	65.33	50.11	17.38	60.04
Dried brewers' grains:					
Sheep 1	61.63	55.11	92.79	77.71	58.70
Sheep 2	61.68	50.04	89.43	80.82	58.96
Average	61.65	52.57	91.11	79.26	57.83
Spring-wheat bran:					
Sheep 2	62.26	22.18	75.67	77.68	69.55
Sheep 3	62.80	25.00[1]	75.53	81.59	71.22
Average	62.53	23.59	75.60	79.63	70.38
Winter-wheat bran:					
Sheep 4	66.45	56.28	60.54	78.54	70.43
Wheat middlings:[2]					
Sheep 1	79.48	32.57	87.99	81.83	84.43
Sheep 4	85.63	40.06	81.71	87.75	91.08
Average	82.55	36.31	84.85	84.79	87.75

[1] Misprinted 0.25 in original.

[2] Very fine and quite light colored.

"The Buffalo gluten feed proves to be quite digestible. The fat has approximately the same degree of digestibility as in corn meal, while the protein appears even more digestible. The cellulose and extract matter, however, fall somewhat below those of the corn meal, as would be expected. . . .

"Corncobs appear fully as digestible as a good quality of English hay, with the exception of the protein, of which they contain but a small amount. . . .

"Winter-wheat bran generally costs about $2 per ton more in the retail markets than the spring bran, and it was our object to see if analysis and digestibility warranted this extra price. So far as composition is concerned, the 2 brans are practically alike. We regret that at present positive conclusions can not be drawn from the digestion experiments. In case of the winter-wheat bran, through an unfortunate circumstance, only the results obtained with 1 sheep can be presented. From the results offered it will be noticed that the protein and extract matter have almost identical coefficients, but the fat appears rather more digestible in the spring bran and the cellulose more digestible in the winter bran. . . .

"The finer grade of wheat middlings coincides very closely in digestibility with Buffalo gluten feed. The chief difference between the 2 feeds is that the Buffalo gluten feed contains about 4 per cent more protein than the wheat middlings."

Fourth feeding experiment with steers, J. B. LINDSEY (*Massachusetts State Sta. Rpt. 1893, pp. 57–76*).

Synopsis.—An experiment with 2 yearling steers to compare different coarse fodders and soiling *vs.* pasturage in summer, and to ascertain the cost of beef production. Hay was found too expensive (at $15) for this purpose. Corn-and-soja-bean silage was satisfactory. The gains were much larger on soiling than on pasturage. The gains during the whole feeding did not repay the total cost of the food, but allowing for value of manure they a little more than covered the net cost.

Previous experiments in steer feeding at this station have been reported in Bulletins 40 and 44 of the station and Annual Reports for 1891 and 1892 (E. S. R., 3, p. 162; 4, pp. 67, 478; and 5, p. 198).

The present experiment was with 2 grade Shorthorn yearling steers weighing about 600 lbs. each, and lasted from December 1, 1891, to February 28, 1893. It was divided into 3 parts—the first winter and spring, the summer feeding, and the second winter feeding. The steers were quite thin when received, and cost 3½ cts. per pound live weight.

First winter and spring feeding (pp. 58–64).—In this period (December 1, 1891, to June 12, 1892) there was fed 3 lbs. of wheat bran with either 3 lbs. of Chicago maize feed or 3 lbs. of Buffalo gluten feed, and hay with turnips, mangel-wurzels, or sugar beets, or corn silage, corn stover, or rye fodder (green). The nutritive ratio ranged from 1 : 5.4 to 1:3.9. The data as to gain in weight, food consumed, and total and net cost of the food are tabulated. In calculating the net cost it is assumed that 92 per cent of the fertilizing ingredients in the food is recovered in the manure. During the period steer 1 gained 297 lbs. and steer 2 271 lbs., or a daily average of 1.52 lbs. for No. 1 and 1.39 lbs. for No. 2, which was not sufficient in either case to repay the total cost of the food, although nearly sufficient to cover its net cost.

"The larger the amount of hay fed the higher the cost of the daily ration. [Hay rated at $15 per ton.] In this experiment, however, a moderate amount of hay in combination with roots and grains has produced beef at a fairly low price. Ration 3, consisting of silage and grain, has also given very favorable results. In the latter case the total cost of feed per pound of live weight gained was 6.35 cts. and the net cost 3.38 cts."

Autumn and second winter feeding (pp. 65–70).—The time covered by this period was from September 5, 1892, to February 28, 1893. At the beginning of the period the steers weighed 1,000 and 1,100 lbs., respectively. A grain ration of 3 to 4 lbs. each of wheat bran and Buffalo gluten feed was fed. The coarse fodder consisted of green fodder corn and serradella, corn stover, and corn-and-soja-bean silage. The nutritive ratio ranged from 1:5.8 to 1:8.7. The data are tabulated as for the previous period, including analyses of the feeding stuffs used with reference to both food and fertilizing ingredients. Steer 1 made an average daily gain of 1.6 lbs. and steer 2 1.78 lbs. It will be noticed that these gains are considerably better than during the first winter feeding. The total cost of food per pound of gain ranged from 7.37 to 9.6 cts., and the net cost from 3.25 to 3.93 cts.

"It again appears that the gain in live weight about covers the net cost of the food consumed. . . . While the growth was much slower when the animals were fed corn stover, yet, because of its comparative cheapness and manurial value, the net cost of beef produced was fairly low.

"Ration 4, consisting of grain and corn-and-soja-bean silage, also gave very favorable results, producing beef at a net cost of 3.25 cts. per pound."

Summer soiling vs. pasturage (pp. 73–76).—The interval between the 2 periods mentioned above was devoted to soiling in the barn, the steers being turned into the barnyard during the day. A mixture of equal parts of wheat bran and Buffalo gluten feed was fed. The coarse

fodder consisted of hay, green corn fodder, green rye, green peas and oats, green vetch and oats, green serradella, cabbages, sugar beets, and a small amount of other green crops.

In summarizing the results the period from May 1 to September 30 is included, since soiling crops were fed at the end of the first season and the beginning of the second season. The results are compared with the average results secured with steers on pasturage in 1890 and 1891. The summary follows:

Comparison of soiling and pasturage for steers.

	Live weight at beginning.	Gain in live weight.	Duration of period.	Average gain in weight per day	Cost of food per pound of gain.	
					Total.	Net
	Pounds.	*Pounds.*	*Days.*	*Pounds.*	*Cents.*	*Cents.*
Soiling:						
Steer No. 1	818	232	153	1.52	8.39	4.08
Steer No. 2	827	188	153	1.23	10.35	5.03
Pasturage:						
1890	867	104	144	0.72	[1] 8.24	....
1891	828	107	190	0.57	[2] 6.36	....

[1] Pasturage at 40 cts. per week. [2] Pasturage at 25 cts. per week.

"The different steers gained from 2 to 3 times as much in live weight per day when fed at home as when pastured.

"The price paid for the pasture will, in a measure, govern the profit and loss of the operation. . . .

"In case of soiling, the net cost of feed required to produce 1 lb. of live weight, 4 to 5 cts., proved to be about one half the total cost. In other words, the chief gain seems to have been in the value of the manure produced."

The advantages and disadvantages of soiling and pasturage are discussed.

The cost of beef production (pp. 70–73).—The 2 steers used in the above experiments were bought November 19, 1891, at 3½ cts. per pound, and sold February 28, 1893, at 4¼ cts. per pound live weight. During the entire experiment steer 1 gained 667 lbs. and steer 2 620 lbs., making an average daily gain of 1.43 lbs. for No. 1 and 1.32 lbs. for No. 2.

The dry matter eaten per pound of gain in live weight was 10.64 lbs. for steer 1 and 10.99 lbs. for steer 2. The total cost of food per pound of gain was 8.55 and 8.9 cts., respectively, and the net cost 4.22 and 4.4 cts., respectively.

"Excluding the cost of labor, the coarse fodder articles and grains have been sold at market rates, and have been a trifle more than paid for in the value of the beef and of the manure produced. . . .

"Taking an average of the 2 steers, the total cost of producing 1 lb. of live weight was 8.7 cts. and the net cost 4¼ cts.

"The average daily gain for the entire experiment (467 days) was 1.37 lbs., and the dry matter required to produce 1 lb. of gain was 10.82 lbs."

Steer and heifer beef, J. WILSON and C. F. CURTIS (*Iowa Sta. Bul. 24, pp. 943–968*).

Synopsis.—A comparison of feeding steers and spayed and unspayed heifers for beef, using 5 animals of each kind. Seven of the heifers calved during the trial, which interfered with the comparison. The steers made the larger gain, and brought 1 ct. per pound live weight more than the heifers. The heifers gave a larger percentage of prime cuts (ribs and loins) than the steers, so that on the basis of the meat and by-products obtained, and the price paid for the steers, the heifers were worth from 0.57 to 0.62 ct. per pound more than was paid for them. Fifteen shotes kept with the steers and heifers added materially to the profit from the feeding.

To compare steers and heifers for beef production, 5 steers and 10 heifers, all yearling grade Shorthorns and as nearly alike in breeding and development as possible, were purchased in the fall of 1892. Five of the heifers were spayed and 5 left unspayed. The experiment commenced January 4, 1893, and lasted until December 1. At the beginning the steers weighed 4,093 lbs., the spayed heifers 3,994 lbs., and the unspayed heifers 3,592 lbs. All 3 lots were fed and treated in the same manner. During the winter and spring they were fed hay, corn stover, beets, ear corn, corn-and-cob meal, and linseed meal; during the summer they received soiling crops and the same grain; and in the fall clover hay, corn fodder, and beets were fed with bran, corn-and-cob meal, and linseed meal. The nutritive ratio of the rations varied from 1:9.1 to 1:11.4. "The heifers were all thought to be clear of calf when bought," but 4 of the unspayed and 3 of the spayed heifers calved during the spring and summer. This of course placed the heifers at a disadvantage as far as gain was concerned. They were dried up as soon as possible, and soon made satisfactory gains. A case of lumpy jaw developed in 1 of the steers, but was successfully treated.

At the conclusion of the experiment the animals were shipped to Chicago and slaughtered by Swift & Co. Full data are tabulated as to the food eaten, gains in weight, shrinkage, and results at slaughtering, including the weight of parts and of different cuts of meat.

"The 5 steers made an average gain of 806 lbs. each, equal to 2.44 lbs. per day; 1 open heifer, clear of calf, gained 775 lbs., equal to 2.35 lbs. per day; 4 open heifers that had calves made an average gain of 628 lbs. each, equal to 1.90 lbs. per day; 2 spayed heifers, clear of calf, made an average gain of 736 lbs. each, equal to 2.23 lbs. per day; 3 spayed heifers that had calves averaged 645 lbs. each, equal to 1.95 lbs. per day."

The steers were sold at 5.75 cts. and the heifers at 4.75 cts. per pound, live weight. Allowing 3.5 cts. per pound for the steers and 2 cts. for the heifers at the beginning of the trial, there was a profit of $64.39 on the steers, $0.51 on the unspayed heifers, and $13.76 on the spayed heifers. "The heifers killed nearly as well as the steers," the average proportion of beef in the carcass being 63.2 per cent for the steers, 62.4 for the unspayed heifers, and 62.8 for the spayed heifers.

"From the weight of different parts of the carcass it is apparent that the heifers give a higher percentage of prime cuts (ribs and loins) and a correspondingly lower

percentage in the cheaper cuts than the steers. The difference amounts to 1 per cent more loin weight and 0.8 per cent more rib in the spayed heifers than in the steers. The open heifers are also better in these parts than the steers, although the advantage is not quite so marked."

Crediting each lot with the actual value of the different cuts and the by-products, and not including the expense of killing and handling, it is calculated that at the prices which the butcher paid he made $20.45 on the steers, $58.12 on the unspayed heifers, and $64.84 on the spayed.

"In other words, the returns made by the heifers would have justified a purchase price of $5.37 per cwt. for the spayed heifers and $5.32 for the open heifers, instead of $4.75 for each, and still have left the same margin of profit as in the steers. It is clear, then, that the difference in value of the steers and heifers was only about 40 cts. per cwt. live weight, instead of $1 per cwt. made by the buyers. This is estimated on the basis of the prices put upon the meat products as shown in the record of the block test, viz, a difference of 1½ cts. per pound on the rib, loin, and plate cuts, and ¼ ct. on the rounds and flanks, in favor of the steers."

The opinions of butchers in this country and in England on the difference in value of steer and heifer beef, and the reasons for this difference are collated.

"The rib and loin cuts of the steers were valued 1½ cts. a pound above those of the heifers by Chicago meat dealers, while English authorities estimated the value of heifer rib and loin cuts 2 cts. per pound above those of steers fattened in the same manner."

Fifteen shotes allowed to run in the yard and stable with the steers and heifers ate 282 lbs. of ear corn and gained 4,005 lbs. They brought 4.5 cts. per pound, giving a profit above the cost of the corn of $118.18.

"The profit from the hogs is equal to $7.87 for each of the cattle, and without it we would have fed at little profit, as far as the heifers are concerned."

Experiments with calves, J. B. LINDSEY (*Massachusetts State Sta. Rpt. 1893, pp. 125–145*).

Synopsis.—Seven calves were fed until 8 to 11 weeks old on skim milk alone or with a little grain. They made an average gain of 1.49 lbs. per day. There was obtained per quart for skim milk 0.64 ct. with veal at 4 cts., and 0.76 ct. with veal at 4½ cts. a pound. These amounts are compared with the returns for skim milk fed to pigs.

To ascertain the amount that can be realized from feeding skim milk to young calves, 7 calves 2 or 3 days old at the beginning of the trial were used. At first the calves were fed a mixture of whole milk and skim milk, but after a week or 10 days this was replaced by a ration of skim milk, either alone or with a little grain. The grain was fed dry with one exception, and *ad libitum.* It consisted of corn meal and mixtures of equal parts of Buffalo gluten feed and old-process linseed meal, of wheat flour and old-process linseed meal, and of Buffalo gluten feed and wheat middlings.

Beginning with ¼ lb. per day of grain the calves consumed as high as 1 lb. per day by the time they were 8 weeks old. These calves drank 10 or 12 qt. of skim milk per day in addition to the grain. The calves receiving skim milk almost exclusively drank about 6 qt. per day at

the beginning, and from 16 to 20 qt. at the close of the trial. A small quantity of limewater was added to the skim milk.

Detailed and summarized records are given for the experiment, and analyses with reference to both food and fertilizing ingredients are given of the feeding stuffs.

The calves were sold when they were from 8 to 11 weeks old. At that time they ranged from 157 to 189 lbs. live weight. Butchers offered from 4 to 4½ cts. per pound live weight. A summary of the results is given below:

Summary of results with calves.

Average daily gain in live weight	pounds	1.49
Dry matter required to produce 1 lb. of live weight	do	1.77
Dry matter required to produce 1 lb. of dressed weight	do	2.98
Shrinkage in dressing	per cent	44.22
Received per quart for skim milk, with calves at 4 cts. per pound	cents	0.63
Received per quart for skim milk, with calves at 4½ cts. per pound	do	0.76

For comparison, the amount received per quart for skim milk when fed to pigs is given, the averages being based on 6 separate experiments with 40 pigs:

Amount received per quart for skim milk fed to pigs.

	Cents.
With dressed pork, at 5½ cts	0.21
With dressed pork, at 6 cts	0.30
With dressed pork, at 6½ cts	0.46
With dressed pork, at 7 cts	0.58
With dressed pork, at 7½ cts	0.70
With dressed pork, at 8 cts	0.81

"The experiments have shown that calves grown upon skim milk alone or upon skim milk and grains during the first 8 weeks of their lives make good gains in live weight, namely, from 0.9 to 2.13 lbs. per day, with an average of 1.49 lbs. These animals, however, put on very little fat, either when fed on skim milk alone or when fed on skim milk and grains. They were not able to digest the necessary amount of corn meal, Buffalo gluten feed, or wheat flour or middlings, when fed in connection with the nitrogenous milk, to promote the formation of fat.

"The meat of the animals thus described was quite white in appearance, but not as tender as calves that were fed whole milk. The ribs and flanks of animals thus fed were thinner than those consuming whole milk, and the shrinkage in dressing is from 5 to 7 per cent more. . . .

"The experiment indicates that in order to secure the greatest profit it is not wise, as a rule, to feed calves as above described after they have reached 160 lbs. of live weight. The daily gain decreases and the food consumption steadily increases, so that the commercial value of a pound of live weight is about balanced by the cost of the food consumed to produce it."

Effect of cotton seed and cotton-seed meal on butter, beef tallow, lard, and sheep suet, H. H. HARRINGTON and D. ADRIANCE (*Texas Sta. Bul. 29, pp. 349–355*).

Synopsis.—The butter made on cotton-seed meal had a melting point several degrees higher than that made on corn meal, bran, and silage. The iodin number was also higher, but the volatile acids were considerably lower. The melting points of beef tallow, lard, and mutton suet were also increased by feeding cotton-seed products, and Beechi's test with nitrate of silver was quite marked.

Effect on butter.—The effect of cotton-seed meal on butter was studied in 2 experiments, 2 cows advanced in the milking period being used in the first and 2 new milch cows in the second. The cows were fed rations composed of hay, silage, corn meal, and wheat bran for periods of about 3 weeks, after which the corn meal and bran were gradually replaced by cotton-seed meal, until in the last period no other grain than cotton-seed meal was fed, and cotton-seed hulls were added. Beginning with 2 lbs. of cotton-seed meal per cow daily, the amount was gradually increased to 6 lbs., but this last amount was only continued a short time for fear of injuring the cows. The butter made on each ration was analyzed and the results are tabulated. A summary follows:

Analyses of butter produced with and without feeding cotton-seed meal.

Food.	Date.	Melting point.	Volatile fatty acids.	Soluble fatty acids.	Insoluble fatty acids.	Iodin number.	Beechi's test.
Cows advanced in milk:		*Deg. C.*	*Cc.*	*Per ct.*	*Per ct.*		
"Herd feed"	Nov. 7	35.9	15.10	4.72	88.74	37.92	Decidedly dark.
Do	10	35.5	18.46	4.80	89.25	35.42	Do.
Corn meal, bran, and silage	Dec. 9	33.6	17.65	4.54	87.66	35.76	Faint color.
Do	20	33.5	21.95	4.57	87.43	35.72	Very faint color.
Do	29	33.1	24.85	5.25	87.45	33.45	Do.
¼ ration of cotton-seed meal	Jan. 12	34.8	28.60	5.33	88.35	32.82	Distinct.
Do	19	35.4	24.05	5.46	88.20	32.39	Dirty brown.
½ ration of cotton-seed meal	27	37.9	21.75	4.88	85.60	35.72	Distinct.
Do	Feb. 6	38.0	21.30	3.82	88.56	32.60	Dark dirty brown.
¾ ration of cotton-seed meal	13	37.9	20.60	3.84	88.89	[1] 27.77	Almost black.
Do	20	39.5	15.45	3.90	89.79	35.78	Do.
Cotton-seed meal and hulls	Mar. 9	41.4	12.15	3.31	91.13	42.34	Do.
New milch cows:							
"Herd feed"	Jan. 9	39.8	22.35	5.14	87.86	30.08	Distinct.
No cotton-seed meal	16	33.8	30.42	4.82	87.68	29.14	No color.
Do	26	33.4	28.95	5.19	87.27	27.00	Do.
¼ ration of cotton-seed meal	Feb. 7	35.9	25.60	4.35	87.06	28.70	Dirty brown.
Do	13	38.3	29.95	4.91	88.18	30.38	Dark brown.
Do	20	38.5	23.40	4.57	88.88	32.32	Do.
½ ration of cotton-seed meal	Mar. 2	39.0	21.95	4.80	87.00	32.01	Do.
Do	6	40.2	20.00	4.64	87.61	33.48	Nearly black.
¾ ration of cotton-seed meal	15	41.5	18.52	4.68	88.91	34.40	Do.
Do	22	41.7	17.03	4.70	89.71	35.00	Do.

[1] "Either an abnormal sample or some error in work."

The effect of the cotton-seed meal is most noticeable on the melting point of the butter, which increased steadily with the amount fed. The volatile fatty acids fluctuated greatly, but there appears to be a general decrease on cotton-seed meal. In general the iodin number increased on cotton-seed meal. Beechi's test for cotton-seed oil with nitrate of silver, which was faint where no cotton-seed meal was fed, gave a dark, nearly black coloration where that material was fed in considerable quantity.

Effect on lard and sheep suet.—Analyses were made of 3 samples of lard, 1 from pigs fattened on cotton-seed meal, another bought in the open market, and a third homemade lard from pigs fattened on corn; and of fat from the kidney, caul, and body of a sheep fed on corn and another fed on cotton-seed meal. The results are given below:

Analyses of lard and sheep suet from animals fed on corn and on cotton-seed meal.

	Melting point.	Volatile fatty acids.	Soluble fatty acids.	Insoluble fatty acids.	Iodin number.	Beechi's test.
Lard.	*Deg. C.*	*Cc.*	*Per ct.*	*Per ct.*		
From pigs fed on cotton-seed meal	46.5	0.0294	0.048	93.76	52.20	Very dark.
Bought in market	35.5	0.0580	Trace.	93.74	54.03	None.
From pigs fed on corn	35.6	0.6200	0.052	94.88	54.76	Do.
Sheep suet.						
From sheep fed on cotton-seed meal:						
Kidney fat	51.5	0.0080	0.028	94.82	31.46	Black.
Caul fat	50.9	0.0140	0.024	93.39	32.21	Dark brown.
Body fat	49.6	0.0101	0.018	94.57	38.64	Black.
From sheep fed on corn meal:						
Kidney fat	47.3	0.0096	0.017	93.60	25.98	None.
Caul fat	47.7	0.0083	Trace.	94.17	26.09	Do.
Body fat	44.7	0.0103	0.058	92.82	27.03	Do.

"The melting point of the lard from cotton-seed meal is notably higher than either of the other melting points, while the test with nitrate of silver was also quite distinct. The volatile acids in normal lard are so small that hardly any difference could be expected in them. There is also nothing distinctive in the iodin absorption. . . .

"The melting points of the kidney fat in the 2 sheep show a difference of a little more than 4°, while the iodin absorption of the body fat shows a variation of more than 11°. It could not be expected that with the very small amount of volatile acid content there would be any variation of importance in these resulting from the 2 feeds. Beechi's test in 1 case was quite distinct, while there was none in the other.

["The effect of food on mutton suet] is almost as marked as upon butter."

Effect on beef tallow.—An experiment was made at the station in fattening steers on corn meal, cotton-seed meal, or raw, boiled, or parched cotton seed, and the opportunity was embraced to test samples of the fat of each lot taken from the kidney, caul, and body. The usual analyses were made, but all the results, except for the melting point and Beechi's test, fluctuated so widely as to furnish no indication of the effect of the food. The melting point and Beechi's test are given below:

Melting point and Beechi's test of beef tallow.

Food.	Melting point.			Beechi's test.
	Kidney fat.	Caul fat.	Body fat.	
Corn:	*Deg. C.*	*Deg. C.*	*Deg. C.*	
One season	46.5	46.7	32.7	None.
Two seasons	46.1	46.3	41.2	Faint.
Cotton-seed meal:				
One season	49.9	50.1	46.4	Nearly black.
Two seasons	47.3	46.5	41.6	Dirty brown.
Raw cotton seed:				
One season	49.9	50.1	45.1	Dirty brown to nearly black.
Two seasons	51.0	48.0	44.4	Dirty brown.
Boiled cotton seed:				
One season	50.2	50.3	45.5	Slightly to nearly black.
Two seasons	50.3	50.3	44.2	Very dark to nearly black.
Parched cotton seed:				
One season	51.3	50.5	47.7	Light brown to very black.
Two seasons	52.1	51.8	50.2	Dirty brown.

The average melting point of the kidney fat is 46.3° C. for the steers fed corn and 50.4° for those fed cotton-seed products—a difference of 4°. The average melting point of the caul fat is 46.5° on corn and 49.7° on cotton-seed products—a difference of over 3°. The average melting point of the body fat is 36.9° on corn and 45.6° on cotton seed products—a difference of nearly 9°.

"The results of the iodin absorption are, however, disappointing. There is no regularity; but, if anything, the effect of the seed and meal seems rather to lower the iodin absorption. With Beechi's test, however, which by some is considered a distinctive test for cotton oil, the fats from the steers fed on [cotton-seed] meal or seed gave decided reactions. . . .

"The body fat is always considerably lower in melting point than either the kidney or caul fat, while the insoluble acids in the body fat run considerably higher. . . .

"Oleomargarine, or more properly butterine, made from beef tallow derived from steers fed on cotton-seed meal and hulls, might give Beechi's test, confusing ordinary chemical tests for pure butter."

Feeding experiments with milch cows, J. B. LINDSEY (*Massachusetts State Sta. Rpt. 1893, pp. 15–45*).

Synopsis.—This includes 2 experiments, the first made to compare hay, rowen, corn stover, hay of peas and oats, and silage made from mixtures of corn and soja beans; and the second to compare rowen, green vetch and oats, and green corn fodder for milk production. These brought out anew the economy of substituting some other coarse fodder for meadow hay. A silage made of a mixture of equal parts of green corn fodder and green soja bean was found to be equal to hay for milk production and much more economical. Milk was produced cheaper on green vetch and oats than on green corn fodder.

General feeding experiments with milch cows (pp. 15–35).—Ten cows, mostly grades in different stages of the milking period, were used. The experiment lasted from October, 1892, to July, 1893, and was divided into 7 periods. The grain ration remained constant throughout the entire experiment, and consisted of 3 lbs. each of wheat bran, Buffalo gluten feed, and cotton-seed meal. The coarse fodders were fed *ad libitum*, and were different for each period, as shown by the following:

Period 1, hay, about 15 lbs.
Period 2, hay and Globe mangel-wurzels, about 15 lbs. each.
Period 3, corn stover, from 12 to 14 lbs. per day.
Period 4, hay, about 4 lbs., and 50 lbs. of corn-and-soja-bean silage.
Period 5, hay, 4 lbs., and about 50 lbs. of soja-bean-and-corn silage.
Period 6, hay of peas and oats, about 15 lbs. per day.
Period 7, rowen hay, 16 to 18 lbs. per day.

The silage fed in the fourth period (corn-and-soja-bean silage) consisted of equal parts, by weight, of green corn fodder and green soja bean, and that fed in the fifth period (soja-bean-and-corn silage) consisted of 2 parts, by weight, of green soja bean and 1 part of green corn fodder. Samples of the milk of each cow were at first taken daily, but later composite samples were made of the milk for 3 days of each week, and analyzed. The record of each cow is given, including the amounts

of food eaten, the quantity and quality of milk produced, and the cost of the feed. Analyses with reference to both food and fertilizing ingredients are given of the feeding stuffs used. In calculating the cost of milk the current prices of feeding stuffs were used, and allowance was made for the value of the fertilizing ingredients obtainable in the manure. The general conclusions from the experiment were as follows:

"This experiment confirms others made at the station, and points out the economy of raising and feeding a greater variety of coarse fodder articles, substituting them for the high-priced hay.

"Corn-and-soja-bean silage has proved itself to be fully equal if not superior to hay in producing a yield of milk, without affecting the quality, and at the same time decreasing the absolute cost. This ration produced milk at less than 2 cts. per quart.

"Roots, while they are beneficial to the health of the animals, especially those fed upon dry fodder, can not be fed to any extent economically, because of the increased cost of the milk produced.

"Hay of peas and oats proved itself to be nearly or quite equal to a good quality of rowen for milk production.

"The different coarse fodders have not influenced the composition of the milk to any noticeable extent."

Summer feeding experiment with milch cows (pp. 36–45).—This experiment lasted from July 13 to August 28, and covered 3 periods of about 3 weeks each. Six cows were used. The rations in different periods were as follows:

Period 1, green vetch and oats *ad libitum*, 4 lbs. rowen hay, and 3 lbs. each of wheat bran, Buffalo gluten feed, and cotton-seed meal.

Period 2, rowen hay *ad libitum* and 3 lbs. each of wheat bran, Buffalo gluten feed, and new-process linseed meal.

Period 3, rowen hay, 4 lbs., green corn fodder *ad libitum*, and 3 lbs. each of wheat bran, Buffalo gluten feed, and new-process linseed meal.

The feeding experiment was conducted like the preceding one. Analyses of the feeding stuffs used with reference to both food and fertilizing ingredients, and the individual records of the cows are given, together with analyses of the milk. Rating rowen hay at $15 per ton, and green vetch and oats, and green-corn fodder at $2.75 and $2.50, respectively, the average cost of food per quart of milk was 2.19 cts. on the green vetch and oats 2.3 cts. on the green-corn fodder, and 2.6 on the rowen hay (second period).

"In case, therefore, of feeding periods 1 and 3, milk was produced at an average price of 2¼ cts. per quart, which is fairly low, considering the advanced period of lactation of 3 of the cows. In feeding period 2, on the other hand, the milk cost 2.6 cts. per quart, which shows that other cheaper coarse fodders must be substituted for the costly hay in order to produce milk at a minimum cost.

"As far as the effect of feed upon the quality of the milk is concerned, there appears to be no distinct steady increase or decrease in composition. . . .

"The results in previous years with soja bean, Southern cowpea, serradella, green rye and peas, and oats have already been published. They point out clearly the fact that a well-regulated system of feeding dairy stock during the summer is necessary in order to secure the most satisfactory results."

Creamery record of Massachusetts State Station for 1892 and 1893, J. B. LINDSEY (*Massachusetts State Sta. Rpt. 1893, pp. 46–56*).—A record is given of the amounts and values of the feeding stuffs consumed by the station herd during 1892 and 1893, the average quality of the milk produced, the net cost of feed for the production of cream, and the amount received for the cream at the local creamery. A statement is also given of the cost of skim milk on the basis of whole milk at 3 cts. per quart, and analyses of cream and butter fat—the latter with reference to fatty acids. The data for the nutritive ratio of the food and the composition of the milk are summarized in the table below:

Nutritive ratio of food and average composition of milk.

Year.	Nutritive ratio of food.		Total solids in milk (monthly average).		Fat in milk (monthly average).		Relation of fat to solids-not-fat in milk.
	Range.	Average.	Range.	Average.	Range.	Average.	
			Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	
1892	1:3.7–1:5.7	1:4.95	12.30–13.75	13.12	3.50–4.55	4.01	1:2.29
1893	1:3.5–1:5.0	1:4.38	13.64–14.01	13.82	4.42–4.84	4.62	1:1.99

The financial statement for the 2 years is as follows:

Finances of creamery record.

Year.	Cost of food per quart of cream.		Received per quart of cream.	Profit per quart of cream.
	Total.	Net.		
	Cents.	*Cents.*	*Cents.*	*Cents.*
1892	13.84	6.21	12.85	6.64
1893	12.36	4.00	13.34	9.34

"The value received for 1 space of cream varied in 1892 from 3.10 to 4.20 cts., with an average of 3.78; in 1893, from 3.50 to 4.25, with an average of 3.91 cts.; which amounted per quart (average) in 1892 to 12.85 cts., and in 1893 to 13.29 cts.

"The number of quarts of milk required to produce 1 space of cream in 1892 was 1.81, and in 1893 1.85, or 6.16 qt. of whole milk to produce 1 qt. of cream in 1892, and 6.29 qt. of whole milk to produce 1 qt. of cream in 1893."

Winter feeding experiment with lambs, J. B. LINDSEY (*Massachusetts State Sta. Rpt. 1893, pp. 77–93*).

Synopsis.—A comparison on 6 yearling sheep of nutritive ratios of 1 : 4.5 and 1:5.5 gave the latter the preference. Substituting corn-and-soja-bean silage for rowen hay reduced the cost per pound of gain. There was a profit from the winter's feeding only when the value of the manure was taken into account.

Six grade Southdown wethers averaging about 60 lbs. each were purchased November 9, 1892, at 6 cts. per pound. After feeding 10 days they were divided into 2 lots, which were fed from November 19 to March 13. Lot 1 was fed a ration of Buffalo gluten feed, cotton-seed meal, and rowen hay, to which corn-and-soja-bean silage was added in the last period. The nutritive ratio of the ration was about 1 : 4.5.

Lot 2 was fed until February 15 a ration of Buffalo gluten feed and rowen hay, with or without corn-and-soja-bean silage, having a nutritive ratio of 1 : 5.5; and from that time to the close of the experiment a ration of Buffalo gluten feed, cotton-seed meal, rowen hay, and corn-and soja-bean silage, with a nutritive ratio of about 1 : 4.5.

The details of the experiment are fully tabulated, including analyses of the feeding stuffs used with reference to both food and fertilizing ingredients. In calculating the cost of the rations, Buffalo gluten feed was reckoned at $21, cotton-seed meal at $28, rowen at $15, and corn-and-soja-bean silage at $2.75 per ton. During the time that the 2 lots were fed rations with different nutritive ratios, *i. e.*, November 19 to February 14, the 3 sheep in lot 1 gained 72.5 lbs., and those in lot 2 67 lbs.; but it is mentioned that 1 sheep in lot 2 suffered from a severe cold during December and made small gains. Had this sheep gained as rapidly as the 2 others in lot 2 "the gains of the 2 lots would have been practically identical." The total cost of the food for lot 1 was $5.46, and for lot 2, $4.96, and the net cost $2.36 and $2.32, respectively.

The substitution of corn-and-soja-bean silage for the larger part of the rowen toward the close of the experiment was accompanied by a reduction in the total and net cost of the food per pound of gain, and also by a slight reduction in the amount of dry matter eaten per pound of gain.

Considering the whole experiment, the cost of producing a pound of live and dressed weight in growing lambs is calculated. The sheep were sheared the day before the experiment began and again at the termination of the experiment. They were bought at 6 cts. per pound live weight and sold at 11 cts. per pound dressed weight.

"The average total cost of feed required to produce 1 lb. of live weight on the retail price of coarse fodders and grains . . . was 7.67 cts. and the net cost 3.41 cts. The total cost per pound of dressed weight was 15.13 cts. and the net cost 6.94 cts.

"The profit and loss account shows that the financial advantages of feeding yearlings during the winter are to be found (1) in selling the coarse fodder articles at a fair retail price, and (2) in the value of the manure produced. . . . The manure (allowing 15 cts. per pound for nitrogen, 5½ for phosphoric acid, and 4½ for potash) has been found to be equal to one half the cost of the feed consumed. . .

"The result of the experiment is in favor of the corn-and-soja-bean silage as a substitute for a larger part of the rowen. . . .

"This experiment would indicate—and it is borne out by the majority of other experiments made with reference to this point—that for the production of lean and fat in case of growing animals a ratio of 1 : 5 to 1 : 5.5 is about as economical a one as can be fed.

"[Concerning the proportion of fat and lean] these results give no positive information, but would indicate in this case that the constitutional tendency of the animal, rather than the feed consumed, governed the amount of fat and flesh produced."

General summary of feeding experiments with growing lambs, 1890–'93, J. B. LINDSEY (*Massachusetts State Sta. Rpt. 1893, pp. 94–98*).—This is a review of the experiments reported in Bulletins 37

and 43 of the station and Annual Reports for 1890, 1891, and 1892 (E. S. R., 2, p. 231; 3, p. 155; 4, pp. 67, 356; and 5, p. 199), together with the experiment given above on feeding growing lambs. The conclusions are that:

"(1) The average total cost of feed required to produce 1 lb. of live weight was 10.32 cts. and the net cost 5.34 cts. . . .

"(2) Narrow rations, 1:4.7, . . . have produced a greater gain in live weight than wide rations, 1:7.

"(3) The total cost of feed required to produce 1 lb. of live weight was about the same in each case, viz, 11.3 cts. and 11.26 cts. per day. The net cost in case of narrow rations was 5.51 cts. per day, against 6.49 cts. per day for wider rations. This shows that the chief advantage of the very narrow rations in these experiments came from the increased value of the manure produced.

"(4) The dry matter required to produce 1 lb. of live weight was about the same in both cases, namely, 11.35 and 11.40 lbs. With the present knowledge of animal nutrition, rations with a nutritive ratio of about 1:5 appear to be the most economical to feed to growing lambs, as well as to steers."

Seven rations are suggested for lambs under 1 year old.

Notes on feeding farm horses, J. B. LINDSEY (*Massachusetts State Sta. Rpt. 1893, pp. 179–182*).—The rations fed to 3 farm horses from 1888 to 1893 are tabulated, and a record is given of the live weights for each month. Analyses are given of the hay, wheat bran, and provender fed. The average amounts of food given are as follows:

Rations fed to horses.

Ration.	Length of time.	Food consumed daily. Hay.	Wheat bran.	Provender.	Nutritive ratio.	Total dry matter.	Total digestible matter.	Cost per day.
		Pounds.	*Pounds.*	*Pounds.*		*Pounds.*	*Pounds.*	*Cents.*
1	Aug., 1888, to June, 1889..	18.00	2.00	6.00	1:7.92	23.23	14.39	23.34
2	June, 1889, to Jan., 1892..	20.00	2.00	6.00	1:7.99	25.03	15.41	24.84
3	Jan., 1892, to May, 1892..	15.00	2.00	4.00	1:7.22	18.78	11.42	18.49
4	May, 1892, to Jan., 1894..	15.00	3.00	6.00	1:7.81	21.43	13.26	22.09

"The so-called provender consists of cracked corn and oats mixed in the proportion of 400 lbs of corn to 15 bu. of oats. . . . Ration 4 contains about the same amount of digestible nutrients as given by Wolff for horses doing average work."

Foods in the year two thousand; Prof. Berthelot's theory that chemistry will displace agriculture, H. J. W. DAM (*McClure's Magazine, 1894, Sept., pp. 303–312*).—An account of an interview with Prof. Berthelot, of Paris, on the future of synthetic chemistry. Prof. Berthelot maintains that several agricultural industries have already been destroyed by chemistry, as, for example, the cultivation of madder root for alizarin for coloring, and others are already in danger; that food nutrients as fats and sugars have already been prepared synthetically from their elements; and that it is quite probable the preparation of others will follow, until ultimately all food materials, beverages, condiments, tobacco, etc., will be made artificially by processes revealed by chemistry instead of from natural products.

The selection of concentrated feeding stuffs, C. PETERSEN (*Milch. Ztg., 23 (1894), No. 36, pp. 571–574*).—A popular article.

The feeding of by-products, G. H. WHITCHER, C. S. PHELPS, P. COLLIER, and J. L. HILLS (*Rural New Yorker, 1894, Sept. 8, p. 566*).

Stock foods and how to use them, E. M. SHELTON (*Ann. Rpt. Dept. Agr. Queensland, 1892–'93, pp. 87–106*).

The food value of fruits, J. F. KENNEDY (*Trans. Iowa Hort. Soc., 28 (1893), pp. 116–121*).—A popular paper on the subject, discussing in a general way the composition of fruits and their digestive and nutritive value. Fruits are separated into the natural divisions of drupaceous, pomaceous, baccate, etc., and are compared with other foods. They are advised to be eaten fresh, either raw or cooked. Dried or canned fruits are also advocated. While less nutritious than some other foods, their wholesomeness is asserted.

Suggestions regarding the cooking of food, E. ATKINSON (*U. S. Dept. Agr., 1894*).—This bulletin is devoted to a discussion of the usual practice of cooking, the waste of heat and of material, the proper method of cooking food, and a description of the Aladdin oven. It contains introductory statements by Ellen H. Richards on the nutritive value of common food materials, the compounding of dietaries, etc.

On extraneous mineral matter in commercial ginger, A. H. ALLEN (*Analyst, 19 (1894), Oct., pp. 207–220*).

Two disputed cases of adulteration (milk and coffee), E. G. CLAYTON (*Analyst, 19 (1894), Oct., pp. 220, 221.*)

Extracts from the evidence given before the select committee on food products adulteration on July 11, 18, and 25 (*Analyst, 19 (1894), Sept., pp. 208–215; Oct., pp. 225–231*).—Evidence relating to milk, milk standards, and decomposed milk.

Miscellaneous fodder analyses (*Massachusetts State Sta. Rpt. 1893, pp. 326–330*).—Analyses are given of corn silage, oat-and-pea silage, silage from *Panicum miliaceum* and from *P. crus-galli*, green millet, soja bean, soja-bean straw, soja-bean meal, cotton-seed meal, cotton-seed hulls, ground oats, wheat bran, dried brewers' grains, new-process linseed meal, Richardson's glucose feed, glucose refuse, starch feed, rye feed, oat feed, proteina, Excelsior feed, cooked feed (oats and corn), gluten feed, gluten meal, pea bran, rice bran, wheat bran, oatmeal and barley refuse, Japanese radish, and cranberries.

Compilation of analyses of fodder articles, fruits, sugar-producing plants, dairy products, etc., C. S. CROCKER (*Massachusetts State Sta. Rpt. 1893, pp. 347–378*).—This is a compilation of analyses made under the direction of C. A. Goessmann from 1868 to 1894.

Tables of the digestibility of American feeding stuffs, J. B. LINDSEY (*Massachusetts State Sta. Rpt. 1893, pp. 379–389*).—This is a compilation of the digestion experiments made in the United States with ruminants and with swine, showing in each case the maximum, minimum, and average coefficients obtained.

Feeding sugar-beet leaves, ZUNTZ (*Ztschr. Zuckerind., 44 (1894), p. 566; abs. in Chem. Ztg., 18 (1894), No. 70, Repert., p. 214*).—In spite of the poisonous action of oxalic acid and its neutral salts, rations of 10 kg. of sugar-beet leaves, which may contain 100 gm. of oxalic acid, are fed in practice without apparent injury. This the author explains on the ground that about half the oxalic acid in the leaves exists as lime salts, which, although dissolved in the stomach, appear not to be resorbed; and that it has long been customary to feed large amounts of calcium carbonate with the leaves, which neutralizes the acid. He recommends following the old practice of mixing the tops with lime and ensiling them.

Use of molasses for feeding, HOLLRUNG (*Ztschr. Zuckerind., 44 (1894), p. 580; abs. in Chem. Ztg., 18 (1894), No. 70, Repert., p. 214*).—The author holds the utilization of molasses in making "molasses feed" (E. S. R., 4, pp. 452, 620) to be advisable, and recommends that sugar factories take up the matter. The best results are obtained when hot molasses (70 to 75° R.) is mixed with an equal weight of freshly ground palm-nut cake. The mixture can be sacked and used immediately. Animals must be accustomed to the food gradually, but when the feeding is properly carried on very favorable results are said to follow, even with milch cows.

The effect of the sun's rays on the breaking down of material in the body, the production of heat, and the excretion of watery vapor by animals, M. RUBNER and E. CRAMER (*Arch. Hyg., 20, No. 4, pp. 345–364*).

Effect of light on the animal body, H. QUINCKE (*Pflüger's Arch. Physiol., 57, No. 3 and 4, pp. 123–148*).

An apparatus for measuring the respiratory gas exchange of human beings on the principle of Regnault, F. HOPPE-SEYLER (*Ztschr. physiol. Chem., 19, No. 6, pp. 574–589*).

Respiration experiments on healthy persons, E. LAVES (*Ztschr. physiol. Chem., 19, No. 6, pp. 591–602*).

Principles of breeding, L. DUMAS (*Bul. Min. Agr. Belgique, 10 (1894), No. 1, pp. 71–76*).—A discussion of the heredity of form, habits, intelligence, health, etc., in breeding domestic animals.

Slaughter experiments and investigations regarding the quality of flesh of animals at the Fat Stock Show in Berlin in 1894, C. LEHMANN (*Deut. landw. Presse, 21 (1894), No. 75, pp. 716, 717; No. 76, pp. 721, 722, figs. 8*).

Feeding calves (*Molk. Ztg., 8 (1894), No. 35, pp. 530, 531*).—Practical directions deduced from the result of scientific work.

Feeding experiments with pigs, J. B. LINDSEY (*Massachusetts State Sta. Rpt. 1893, pp. 99–124*).—This is a detailed account of the eighteenth and nineteenth pig-feeding experiments at the station, a brief account of which was given in Bulletin 47 of the station (E. S. R., 5, p. 74).

VETERINARY SCIENCE.

The use of Koch's lymph in the diagnosis of tuberculosis of cattle, J. NELSON (*New Jersey Sta. Bul. 101, pp. 79, charts 5*).—An account of the work of ridding the college farm herd of tuberculous cattle, a general discussion of tuberculosis, a record of temperatures of animals injected and of the results of autopsies, and a technical discussion of the results secured.

Forty-one animals were injected with tuberculin; 24 showed reactions, and in all these cases except 2, which were doubtful, tuberculous lesions were found on *post-mortem* examination.

Following is the author's summary:

"(1) A 'reaction' consists in the recognition by the body of the presence of toxins to which the previous presence of tubercle bacilli has rendered the tissues sensitive. It is incapable of exact measurement and can best be determined from a calculated normal, the location of which can be approximately fixed from an extended series of temperature observations on the individual whose record is in doubt. It can also be located as being certainly below a fixed maximum determined for the herd, and, finally, the initial temperature gives a clue to it, because the latitude of individual variation is only half that of the herd as a whole, viz, about 2.2°. Furthermore, the associations of normal temperatures with the initial evening record is such that a yet closer approximation may be made.

"(2) Thus, the determination of the reaction reduces itself to a revision of the ordinary method (that, viz, by taking the difference between the initial temperature and the maximum record) by incorporating the principle that the temperature of an animal tends to vibrate about a fixed mean, with fixed maximal limits of oscillation, beyond which any excess must be certainly predicated as a reaction. Furthermore, that this reaction is an extended affair, the true total reaction being the integral of the reaction curve.

"(3) The duration of a reaction is proportional to the greatest height thereof.

"(4) The higher the reaction the sooner it occurs.

"(5) The height of reaction is no index to the amount of tuberculosis present.

"(6) The amount of tuberculosis increases regularly with the age of the victim.

"(7) There is little difference between the different breeds of high-bred cattle so far as their susceptibility to tuberculosis goes; but grades, crosses, and especially 'native' cattle appear somewhat less subject to its development.

"(8) The total reaction tends to be greater in cases of slight than in cases of well-developed tubercle.

"(9) The normal temperatures of young animals range higher than those of the older ones.

"(10) While the diagnosis of tubercle from physical examination is dependent on the presence of tubercle in the lungs, there is no certainty that even well-advanced cases can be thus discovered, nor does it necessarily follow that all suspected tuberculous animals have lesions of the lungs. In the absence of lung lesions, however, the chance of discovery of advanced cases of this disease by physical means is but slight. It also happens that a number of cows not suffering from tubercle are usually included as 'suspected' by this sort of diagnosis. Certainly at least twice as great accuracy in discovering tuberculous cattle results from the use of Koch's lymph as from all other means combined.

"(11) Slight cases of reaction may occur later than 15 hours after injection; and, to be certain that all cases have been given a chance to make a record, the observations following injection should be continued for 24 hours at least.

"(12) If the object of injection be to eradicate the disease utterly from a herd, the reacting cases should be arranged in the order of the certainty of the reaction (in a few cases it will be needful to continue the temperature observations for several days to gain a knowledge of the probable 'normal') and killed *seriatim* until among the doubtful cases there occur at least 2 in immediate succession which are adjudged sound after extremely thorough examination of all lymphatic structures and places where connective tissue abounds. Then the premises should be thoroughly cleaned and disinfected, and no new animals admitted until they have passed the 'test.' Finally, to keep the herd 'clean' the animals should be tested annually or biennially. . . .

"The highest expected [normal] temperature for any period does not exceed 102.6° nor fall below 100.2°, and between these points is roughly 1° above the initial evening temperature. Especially in the morning is a rise of more than a degree above the initial evening temperature (between 100° and 102.6°) to be looked at with suspicion if injection has taken place."

Tuberculosis and the tuberculin test, H. L. RUSSELL (*Wisconsin Sta. Bul. 40, pp. 47*).—A general discussion of tuberculosis and of tuberculin, directions for using tuberculin, a comparison of 2 brands of tuberculin, and a detailed record of the tuberculin test made on 30 head of cattle, and autopsy notes on the animals slaughtered. One of the preparations used was made by Dr. Libbertz, of Berlin; the other, by the Bureau of Animal Industry of this Department. For comparison 18 animals were selected, 9 being inoculated with each brand; 7 weeks later all were inoculated again, those which had first been treated with the domestic tuberculin now receiving the imported lymph, while those first inoculated with imported tuberculin were inoculated with the domestic article. In several instances animals that had reacted on the first injection with the Department tuberculin failed to react when 7 weeks later they were inoculated with the imported article. This the author believes to have been due to the smaller quantity of the foreign tuberculin employed at the time when the herd was tested for the second time. The diagnoses based on results of the injection of domestic tuberculin were confirmed by autopsies in 14 out of 15 cases, or 93 per cent.

The testimony of the foreign tuberculin was substantiated by autopsies in 21 out of 28 instances, or excluding those animals that received the imported lymph after having been injected with the stronger domestic tuberculin, the foreign article gave correct indications in 18 out of 21 cases, or 86 per cent.

In addition to the animals used in the above comparison 12 others were inoculated, making 30 subjected to the test.

"Of these, 25 reacted and the remainder were declared healthy. The autopsy record shows that in every one of the 25 reacting animals evident lesions of the disease were discovered.

"Of the 5 animals that failed to react 3 were slaughtered, and 1 of these was found to be somewhat diseased, so that in the 28 cases where *post-mortems* were made it [tuberculin] failed only once."

A physical examination by a veterinarian gave correct diagnoses in only 6 out of 15 cases. Of 26 tuberculous animals 36 per cent showed tuberculous lesions in the pharyngeal and submaxillary lymph glands, 81 per cent in the bronchial and mediastinal lymph glands, 44 per cent in the right lung, 52 per cent in the left lung, and 48 per cent in the mesenteric glands. "Such a preponderance of cases showing undoubted pulmonary infection indicates strongly the danger that closely housed animals undergo, if the disease is once introduced into their midst."

Of 8 calves slaughtered, aged from 7 weeks to 6 months, 7 were decidedly tuberculous; 5 "were more or less diseased in the abdominal organs, indicating a probable contamination from infected food or drink. As the milk is now known to have contained germs of this disease, there is hardly any question but that the intestinal infection was due to the milk fed them during this short period."

The author recommends the use of tuberculin in herds supplying consumers with milk and in the purchase of additions to any healthy herd. "The probability of a sufficiently large number [of tubercle bacilli] being incorporated into butter or cheese is so small as to reduce this chance for infection to a minimum."

A case of glanders in man apparently cured by mallein, A. Bonome (*Deut. med. Wochenschr., 1894, No. 37, p. 725*).—A lad about 17 years old, who had contracted a severe case of glanders from working about horses that had profuse nasal discharges, was treated by the author with injections of mallein and a cure apparently effected. The first 7 injections of 3 drops in 1 cc. of sterilized water, given at intervals of 2 or 3 days, caused an increase of about 2 to 3° C. in the temperature, except in the case of the second and fourth injections. The reactions following the injections were similar to those observed in the horse. Fourteen more injections were made, using 6 drops of mallein, with a diminished reaction. Two months after the first injection the patient was dismissed from the hospital apparently cured.

This is the first case on record where mallein has been used for curing the disease in man, although cures have been accomplished in horses by

its use.[1] The effort which is gradually being made to rid the country of glanders has placed in the hands of many a reliable sterilized preparation of mallein manufactured in the biochemic laboratory of the Bureau of Animal Industry of this Department, which may be used in treating glanders in man.—E. A. DE SCHWEINITZ.

The cow in relation to public health, E. P. NILES (*Virginia Sta. Bul. 32, pp. 121-126*).—A discussion of the sanitary conditions under which cattle are most apt to contract disease, with special precautions for preventing the spread of tuberculosis and typhoid fever through the milk.

Actinomyces gruberi, n. sp., C. TERNI (*Centbl. Bakt. und. Par., 16 (1894), No. 8 and 9, pp. 362, 363*).—A new species of actinomyces found by the author in soil.

Concerning a strongylus (Sclerostomum pinguicola) in the kidney of pigs, P. S. DE MAGALHAES (*Centbl. Bakt. und Par., 16 (1894), No. 7, pp. 292-297, fig. 1*).

Poisonous fodder plants, J. R. JACKSON (*Sci. Amer. Suppl., 38 (1894), No. 978*).—Poisonous properties of *Lathyrus sativus*, *Sophora secundifolia*, *Gastrololium* sp., *Tephrosia* sp., *Swansonia* sp., *Euphorbia drummondi*, and other plants.

DAIRYING.

Concerning citric acid and phosphate of lime in solution in milk, L. VAUDIN (*Ann. Inst. Pasteur, 8 (1894), No. 7, pp. 502-505*).—From the milk of a cow the author obtained orthorhombic crystals having the same elementary composition as citric acid. In solution they exerted no influence on polarized light. The point of fusion of the acid found was 147° C., approximately that of citric acid. The reactions of the salts of the acid found were those of citrates. From experiments made on milk and on artificial solutions containing citric acid and phosphate, the author concludes that citric acid in the form of an alkaline salt contained in milk is to a large extent the agency by which phosphate of lime is held in solution, and that the citrates and alkaline phosphates and the dissolved phosphate of lime exist in milk in proportions relatively definite.

According to the author, a liter of cows' milk contains 1.5 gm. and a liter of mares' milk 0.06 to 0.08 gm. of citric acid.

The chemical composition of cows' colostrum, L. VAUDIN (*Bul. Soc. Chim. Paris, 11-12 (1894), No. 13, pp. 623-625*).—Analyses are given of colostrum taken on the evening before calving, immediately after calving, and 5 days after calving, as follows:

Analyses of colostrum.

	Evening before calving.	Immediately after calving.				Five days after calving.
		I [2]	II [2]	III [2]	IV [2]	
"Extract" at 95° C. (solids?)	27.615	24.49	27.356	22.470	24.17	14.37
Fat	1.300	6.32	3.840	1.360	2.42	5.18
Milk sugar	1.520	2.17	2.366	1.023	2.86	4.07
Soluble ash	.278	.25	.220	.271	.19	.26
Insoluble ash	.809	.84	.830	.791	1.02	.51
Calcium phosphate	.622	.63	.660	.605	.87	.38
Proteids	23.705	14.91	20.100	19.025	17.68	4.35
Acidity per liter (P_2O_5)	3.480	2.72	3.360	2.640	2.80	1.60

[1] U. S. Dept. Agr., Rpt. of Secretary for 1892, p. 119.

[2] Presumably different cows.

The total ash is much higher than in ordinary milk, and also the insoluble ash, notably the calcium phosphate. But a comparison of the total ash with the total solids and the proteids indicates the increase to be more apparent than real. A considerable variation between the relation of the lime, phosphates, and albuminoids of colostrum and of ordinary milk is believed to be one of the causes of difference between the curd of colostrum and the casein of normal milk, and may account for the difference in behavior of colostrum towards heat and reagents. The ash of colostrum differs from that of normal milk further in containing more sulphates. The author has observed that although sulphates are a normal constituent of cows' milk, they increase in amount as the cow approaches calving and gradually decrease to the normal after calving.

The relation of the acidity to the proteids is less in colostrum than in normal milk; in other words, "the albuminoids of colostrum are less acid than those of normal milk."

Investigation on the fat of human milk, E. LAVES (*Ztschr. physiol. Chem., 19, No. 4 and 5, pp. 369–377*).—For his investigation the author had 116 gm. of fat, which Prof. Julius Lehmann had obtained as a by-product in a lengthy investigation on human milk. The fat was found very poor in volatile acids, especially in butyric acid, and in water-soluble acids. For instance, only 1.48 per cent of the total fatty acids were volatile, and of these volatile acids 50.2 per cent were soluble. Lerch found that 10 per cent of the fatty acids of cows' milk was volatile, and that 90 per cent of the latter was soluble. The fat of human milk was found to contain 49.4 per cent of unsaturated acids (calculated as oleic acid), while the amount in cows' butter ranges from 31.75 to 47.85 per cent. The melting point of the insoluble non-volatile acids was found to be between 37 and 39° C., while that for the corresponding fats of cows' milk is given as 41 to 44°. The melting point of the fat was 30 to 31° C. Besides the acids common to animal fats—stearic, palmitic, and oleic acids—there was found a fatty acid of low molecular weight, believed to be myristic acid.

The author concludes that in chemical composition the fat of human milk is essentially different from the fat of cows' milk.

Tests of milk and cream (*Agriculture of Massachusetts, 1893, pp. 247, 248*).—During the year the Dairy Bureau tested 306 samples of whole milk, buttermilk, skim milk, and cream by means of the Babcock test, many of the tests being made at public meetings. The results are summarized. Over one half of the samples of herd milk tested contained 4.4 per cent of fat or more.

"Milk from the top of a can which had been standing less than half an hour tested 4.20 per cent, and from the bottom of the can 4 per cent; from a can which had been standing 4 hours, milk from the top tested 5.40 per cent of fat, and from the bottom 4.80. The bottom of a can, from which the top had been poured as needed for domestic use, tested only 1.60 per cent of fat. Several specimens of strippings tested from 8.20 to 14 per cent, and samples from the first of several milkings went as low as 1.20 per cent of fat."

Over two thirds of the samples of buttermilk had 0.2 per cent of fat or less, and over one half of the samples of skim milk had 0.1 per cent or less. The cream tested ranged from 10.6 to 42 per cent of fat, the majority of the samples having between 15 and 20 per cent.

"With the increasing demand for cream by the city trade, it is apparent from the above range that the door is open for much dishonesty. A legal standard—as in the case of milk—may become necessary. But much better would be the introduction of the system of selling on quality, the producer or dealer guaranteeing on the label of the bottle or can a certain per cent of richness."

Analyses of butter (*Kentucky Sta. Rpt. 1891, pp. 9, 10*).—In connection with a test of a Jersey cow, the milk of each day was creamed and churned and analyses made of the butter. As care was taken to have the treatment in all respects as nearly uniform as possible, the analyses show how wide the variation may be, even with the greatest care of manipulation. The percentage of water in the butter ranged from 12.24 to 20.64, the fat ranged from 71.5 to 82.02, and the salt and curd from 3.84 to 8.22.

Butter analyses (*Kentucky Sta. Rpt. 1892, pp. 9, 10*).—Analyses of samples of butter made from the milk of 2 Jerseys at the station farm show the following variations: In 9 samples from 1 cow the water ranged from 12.7 to 17.09, the fat from 73.77 to 80.98, and the salt and curd from 5.55 to 10.07 per cent; in 9 samples from another cow the water ranged from 13.06 to 18.46, the fat from 73.6 to 82.14, and the salt and curd from 4.74 to 11.95 per cent.

"The manipulation was as uniform as possible, and the results show the difficulty of obtaining perfect uniformity in the product under ordinary conditions, as well as the difficulty of correctly sampling a small amount of butter."

Butter exhibition in Massachusetts (*Agriculture of Massachusetts, 1893, pp. 245, 246.*)—A butter exhibition was held by the Dairy Bureau in connection with the winter meeting of the State Board of Agriculture at Great Barrington. Of the 67 samples entered, 49 were from private dairies, 12 from creameries, 2 were unsalted, and 4 were granular samples. The record of the judges is given.

"After the exhibition most of the samples were analyzed. The water content ranged from 7.20 to 15.80 per cent.

	Per cent.
6 samples had below	9
8 samples had between	9 and 10
17 samples had between	10 and 11
13 samples had between	11 and 12
8 samples had	12 or over.

"The amount of salt ranged from 1.40 to 6.95 per cent.

"The amount of casein ranged from 0.49 to 8.24. The sample having the extraordinary amount of 8.24 per cent of casein was terribly rancid. Thirty-six of the 52 samples had less than 1 per cent of casein.

"The amount of butter fat in the 52 samples analyzed ranged from 79 to 88.90 per cent.

	Per cent.
3 samples had from	79 to 80
2 samples had from	80 to 81
1 sample had	81.40
6 samples had from	82 to 83
5 samples had from	83 to 84
6 samples had from	84 to 85
10 samples had from	85 to 86
8 samples had from	86 to 87
8 samples had from	87 to 88
3 samples had	88 and above.

On the composition of cheese, W. CHATTAWAY, T. H. PEARMAIN, and C. G. MOOR (*Analyst, 19 (1894), July, pp. 145–147*).—Analyses of 31 samples of cheese, including Cheddar (English and Canadian), American, Gongonzola, Dutch, Gruyère, Stilton, Cheshire, double Gloucester, Camembert, Parmesan, Roquefort, Borden, York cream, and double cream. One of the American samples was pronounced margarine cheese. "In conclusion we would urge that cheese should not be so neglected by analysts and inspectors, and that attention should be more particularly directed to American cheeses."

Dairy experiments, A. H. WHEATON (*South Dakota Sta. Bul. 39, pp. 20*).—*Separator tests.*—During April and part of May the station was furnished with milk for separator test by a farmer living some distance from the station. The milk was separated at the station with a De Laval power separator. On a number of days the farmer separated the milk at home by means of a De Laval hand separator and brought the cream to the station. This furnished the basis for a comparison of the power and hand separators, which was as follows·

Trials with hand and power separators.

	Power.	Hand.
	Pounds.	*Pounds.*
Average amount of milk required per pound of butter	25.20	23.66
Average amount of cream required per pound of butter	3.79	3.50
Average amount of milk required per pound of cream	6.62	6.75

The average percentage of fat in the milk brought to the station was 3.75.

Gravity vs. centrifugal creaming.—For 5 days during September the milk was divided into 3 equal parts, 1 part being separated by the De Laval Baby separator, another set in cans in a Cooley creamer without ice, and a third set in shallow pans. The milk was set in each case about 24 hours. The average percentage of fat in the skim milk was as follows: Centrifugal creaming, 0.033; Cooley creamer, 0.38, and shallow pans 0.55. The cream was churned, and the results as given show that the amount of milk required to make 1 lb. of butter was 17.14 lbs. when the separator was used, 19.31 lbs. when the Cooley creamer was used, and 17.79 lbs. when the cream was raised in shallow pans.

This last result is at variance with the thoroughness of the creaming, as shown by the percentage of fat in the skim milk.

Analyses of milk.—The results are given of tests with the Babcock test of some 68 samples of milk brought to farmers' institutes by farmers, and of a number of samples of skim milk and buttermilk. The percentage of fat in a number of samples indicated that they were not normal milk.

Record of college herd.—The yield of milk during 1893 is tabulated by months.

Some reasons why the legal milk standard of New York State should be changed (*New York State Sta. Bul. 70, n. ser., pp. 303–319.*)—The legal standard for milk in New York State is 12 per cent of total solids and 3 per cent of fat. The author contends that this standard may do positive injustice to honest producers and dealers, and, on the other hand, does not afford complete protection from skimming and watering milk. The extensive analyses of milk made by the station in connection with its investigation on cheese-making furnish, the author believes, the most reliable data yet obtained as to the quality of the average milk produced in the State. These data show that the proportion of 3 per cent of fat to 12 per cent of solids is wrong, since "on an average, normal milk containing 3 per cent of fat contains only 11.25 or 11.50 per cent of total solids. To contain 12 per cent of total solids we must have normal milk containing about 3.5 per cent of fat." The result is that milk containing less than 3.5 per cent of fat will usually be found below 12 per cent in solids, and hence condemned as adulterated. "Strictly enforced, our present milk standard would declare as adulterated the greater proportion of milk produced in April and early May." The proportion of 3 to 12 is said to occur only in partially skimmed milk. The milk standards of a number of States and cities are given. It is suggested that skimming might be detected "by making a separate standard to apply only to skim milk, in which skim milk should be defined as any milk which contains less than 1.3 lbs. of fat for 1 lb. of casein. No matter if milk contains 13 per cent of total solids and 4 per cent of fat, it is a skimmed milk if the fat and casein are present in a ratio of less than 1.3 lbs. of fat for 1 lb. of casein."

Although the present standard for whole milk is considered "unfair and incomplete," no change is advocated, since it is believed that lowering the standard would lead to increased adulteration. The remedy proposed is that the standard be practically done away with, and the following substituted instead:

> "Every person selling milk at retail should be compelled by law to place in conspicuous figures on each can or vessel in or from which milk is sold the per cent of fat in the milk; he should be required to guarantee this, and be prosecuted if an examination showed the milk to be below the guarantee."

In support of this proposition it is urged that "fat in milk is really the constituent which determines the market value of milk," as

instanced by the difference in price paid for cream, for rich milk, for skim milk, etc.; that its enforcement would be less difficult and expensive than in the case of the present law; that it would be more effective in preventing skimming or watering, and encourage the production of better milk; and that the Babcock test makes the scheme practicable. It would be a step in the same direction as the "relative-value plan" so rapidly finding application in creameries and cheese factories.

Some reasons why there should be a legal standard for cheese in New York State (*New York State Sta. Bul. 71, n. ser., pp. 321–340*).—The extensive investigations by the station in cheese-making have thrown much light upon the composition of cheese, the relation of ingredients to each other, and the distribution of ingredients in cheese-making. The author proposes to make practical application of this knowledge in revising the cheese standard of the State. He discusses the standards of Minnesota, Ohio, Wisconsin, and New York, all of which appear to him to be open to greater or less objection. For instance, the Minnesota law classes all cheeses containing over 40 per cent of fat in the total solids as whole-milk cheese. This standard the author contends is too low, since it allows the removal of from one fourth to one third of the fat from the milk. He states that in their investigations with milk containing from 3 to 5.25 per cent of fat, the percentage of fat in the total cheese solids varied in 2 years from 50.39 to 56.83, and averaged 53.56 per cent.

"We therefore feel justified in saying that only in case of cheese made from skimmed milk shall we find the fat amount to less than 50 per cent of the total cheese solids, while in case of cheese made from normal milk we shall find the fat amount to never less than 50 and, generally, to over 52 per cent of the cheese solids."

The present law in New York "permits anyone to mark cheese made from normal milk as 'full-milk cheese,' and provides that the brand shall be used on no other cheese," but it provides no standard for "full-milk cheese," and hence no means of preventing fraud. The author believes it is possible to distinguish with certainty between cheese made from whole milk and from milk which has been partially skimmed. The investigatione above referred to have shown that, on an average, cheese made from whole milk contains 1.4 lbs. of fat for 1 lb. of casein, and that this ratio very rarely falls as low as 1.3 fat to 1 casein.

"In our whole experience we have found only two instances in which the ratio of fat to casein fell below 1.3, and in those cases, one in 1892 and one in 1893, the relation was 1.27 lbs. of fat for 1 lb. of casein. We have never yet found a single instance where cheese known to be made from normal milk contained less than 1.27 lbs. of fat for 1 lb. of casein."

This leads the author to suggest that "cheese which contains 1.25 or more lbs. of fat for 1 lb. of casein be legally known as 'full cream' (or 'full milk,' or 'whole milk,' or 'normal milk') cheese; and that all cheese which contains less than 1.25 lbs. of fat for 1 lb. of casein be legally known as 'skim-milk' cheese; and that all factory cheese made in this State be marked with one of these two brands."

The reasons urged for a legal distinction between whole-milk and skim-milk cheese are that in the eyes of the food laws of the State skim-milk cheese is an adulterated food; that the motive which lies at the basis of its manufacture is wrong, "because it expects to gain something from selling an adulterated article for more than it is worth;" that it is of less value than whole milk cheese, is much less digestible, and is more rapidly perishable; and that its manufacture and sale tends to demoralize dealers and to injure the growth and prosperity of the cheese industry.

The arguments for and against the proposed change in the law are considered.

The behavior of milk to rennet, and the "rennet test" of milk, R. LEZÉ and E. HILSONT (*Compt. Rend., 118 (1894), p. 1069, and Jour. de l'Agr., 1894, May; abs. in Milch Ztg., 23 (1894), No. 23, pp. 362, 363, and Chem. Centbl., 1894, II, No. 5, p. 259*).—The authors studied the action of rennet on milk with a view to applying the results in testing milk for freshness and quality. They used a solution of 1 part commercial rennet extract to 10 parts of water, adding 1 cc. of this to 100 cc. of milk, and observing the length of time required to curdle the milk at 35° C. Aërated milk curdles more slowly, and milk treated with carbonic acid more rapidly. The effect of carbonic acid was also apparent in the fresh milk, which curdled more quickly than after standing 2 or 3 hours. The milk solids, and especially the fat, were found to accelerate the action of rennet. Thus skim milk curdled in 6 minutes and 4 seconds, milk mixed with 20 per cent of cream in 4 minutes and 24 seconds, and milk with 50 per cent of cream in 2 minutes and 48 seconds. The addition of starch or sawdust to milk also hastened the action. Previous heating, on the other hand, especially above 70° C., delayed the action, and boiled milk curdled very slowly and imperfectly. The addition of water to milk retarded curdling somewhat. Pure milk which curdled in 3 minutes and 11 seconds curdled in 3 minutes and 14 seconds when 5 per cent of water was added, in 3 minutes and 14 seconds with 10 per cent, in 3 minutes and 20 seconds with 20 per cent, in 4 minutes and 8 seconds with 30 per cent, and in 5 minutes and 49 seconds with 50 per cent of water. Souring shortened the time required for curdling with rennet, as might be expected.

The authors draw the following conclusions as to the indications of the quality of milk from the rennet test: Milk of good quality curdles in 3½ to 4 minutes, the curd being clean, homogenous, and a clear porcelain white. If a longer or shorter time than this is required, or if the curd is crumbly, tough, or dull-colored, the milk is of doubtful quality, and should be submitted to closer analysis. Too slow curdling indicates the addition of water or an alkaline preservative, or possibly previous heating. Very rapid curdling indicates the addition of foreign substances, or that the milk has commenced to sour. A milk which

curdles in less than 2 minutes should be rejected, as it is unfit for direct consumption or for cheese-making.

Impurities and bacteria in the market milk of Christiania, L. SCHMELCK (*Rev. Internat. Falsif., 7, pp. 185, 186; abs. in Chem. Centbl., 1894, II, No. 10, p. 485*).—Six hours after milking the milk from 50 dairies showed the following impurities in August and November, 1893:

Dirt and bacteria in market milk of Christiania.

	Dirt (milligrams per liter).			Number of bacteria per cubic centimeter.		
	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.
August	3	36	11	300,000	45,000,000	2,800,000
November	3	30	10	160,000	6,400,000	1,500,000

The dirt consisted principally of cow excrement. The August milk showed a sour reaction after 2 to 4 hours; the November milk after 24 hours.

Changes during cheese ripening, G. E. PATRICK (*Iowa Sta. Bul. 24, pp. 969–984*).—The changes in weight and in composition of 16 cheeses were studied. Analyses are given of the green cheeses each month for 5 months, and the changes in the amounts of ingredients per 100 lbs. of cheese are calculated. A summary of the observations is as follows:

"The loss in weight during ripening for 5 months, including mechanical losses caused by leakage and scraping of the cheeses, ranged from 14 to 24 per cent, averaging 17.8; without including the scrapings the average was 16.1 per cent. The corresponding averages for 4 months were 14.7 and 13.5 per cent, respectively, including and excluding the losses by scraping.

"The loss of water in ripening for 5 months ranged, per 100 lbs. of cheese, from 7.4 to 16.5 lbs., averaging 11.1. For 4 months the average was 9.2 lbs.

"The entire loss (both mechanical and chemical) of fat in 5 months ranged, per 100 lbs. of cheese, from 1 to 11 lbs., averaging 4.3 lbs. For 4 months the average was 3.6 lbs. Doubtless a considerable part of this loss was mechanical, from leakage and scrapings, but how much can not be stated. . . .

"The total loss of nitrogenous matters (all calculated as casein) in 5 months ranged, per 100 lbs. of cheese, from 0.41 lb. to 2.59 lbs., averaging 1.46. For 4 months the average was 1.26 lbs. These losses are respectively 7.20 and 6.14 per cent of the casein of the green cheeses. What part of these losses, if any, is chemical and what part mechanical, from leakage and scrapings, can not be stated. . . .

"At the end of 5 months (more exactly, 22 to 27 weeks), an average of about 37 per cent of the original casein, or products derived from it by ripening, were found to be soluble in water—a part in the form of amids and a small amount as ammonium compounds. . . .

"The acidity appears to increase slightly during one or two months, and thereafter to gradually diminish. Calculated as lactic acid, it averaged 1.40 per cent of the weight of the green cheeses, increasing to 1.95 per cent during the first 2 months, and thereafter diminishing to 1.44 per cent at the end of the fifth month. . . .

"This diminution is supposed to be due, not to destruction, but to neutralization of acids and acid salts, by ammonia resulting from the decomposition of casein."

A new yeast fermenting milk sugar and causing cheese to swell, N. BOCHICCHIO (*Staz. Sper. Agr. Ital., 26 (1894), No. 6, pp. 568–592; and Centbl. Bakt. und Par., 15 (1894), pp. 546–552*).—In Lombardy "Grana" cheese 4 days old an undescribed form of yeast was found which fermented milk sugar rapidly with the evolution of quantities of gas, principally CO_2. The yeast is usually somewhat elliptical in form. It curdles sterilized milk slowly, and partially liquefies the curd without producing any perceptible acidity. Hard cheese made from milk inoculated with the yeast begins to swell when kept at a temperature of 20° C. The whey is frothy and not an unpleasant drink. The yeast is checked by a temperature of 55 to 60° C., so that infected utensils could be readily cleaned with boiling water. The name suggested by the author for the new yeast is *Lactomyces inflans caseigrana* (milk sugar-fermenting-cheese-swelling yeast of Grana cheese.)

Analyses of milk (*Massachusetts State Sta. Rpt. 1893, p. 331*).—Analyses of 26 samples of whole milk, skim milk, and whey sent to the station for analysis.

Investigations on the milk of different species of animals, A. PIZZI (*Staz. Sper. Agr. Ital., 26 (1894), No. 6, pp. 615–639*).—Determination of volatile acids in human milk and in that of goats, sheep, buffaloes, mares, asses, rabbits, sows, bitches, cats, and rats; analyses of milk of the sheep, goat, buffalo, and rabbit; size of globules in milk of animals mentioned above; and investigations on colostrum of the cow.

Fresh and boiled milk, E. SPATH (*Forsch. ü. Lebensmtl., 1, p. 344; abs. in Chem. Centbl., 1894, II, No. 10, p. 486*).—It was found that the lactodensimeter reading, specific gravity of the milk and of the serum, and percentage of solids, fat, solids-not-fat, and milk sugar, were not materially different in milk before and after boiling, especially if the boiled samples were made to their original volume.

The principles of modern dairy practice from a bacteriological point of view, G. GROTENFELT and F. W. WOLL (*New York: John Wiley & Sons, 1894, pp. 285, figs. 30*).—The basis of this book is a work by G. Grotenfelt, president of the Mustiala Agricultural College, Finland. This Professor Woll has translated and edited with a view to making it directly applicable to the methods and conditions of this country. He has added to the original the results of recent investigations in this country and abroad, and numerous footnotes and references furnishing a concise and systematic review of the present status of practical dairy bacteriology.

The editor had the assistance of Dr. H. L. Russell, assistant professor of bacteriology in Wisconsin University.

The book opens with a discussion on bacteria and their relations to dairying, and closes with a description of the part which bacteria play in the proper ripening of cheese; and all through the book the importance of bacteria in every process of dairying, and the necessity of controlling their action, is pointed out.

The special lines of dairy work treated of are milk production, butter-making, and cheese-making. In connection with the discussion of these, chapters are given on milk as drawn from the udder, sources of infection in the stable and prevention, the common forms of bacteria found in cows' milk, cleanliness in butter and cheese factories, sterilizing and pasteurizing whole milk and skim milk, creaming milk, treatment of cream previous to churning, sweet-cream butter, sour-cream butter, the use of pure culture acid starters, manufacture and handling of butter, diseases of butter, and bacteria in cheese-making.

In discussing the use of pure cultures for ripening cream the author (Grotenfelt) says:

"In my experiments along this line I have not, among the numerous bacteria examined, been able to show any one bacterium possessing all the valuable qualities

desired, but by cultivating two different organisms and mixing them at the same time in the milk used for a starter, I have succeeded in obtaining a starter which produced both good acid and an excellent flavor in the cream. I have either used a short bacterium, previously described by me under the name of *Bacterium acidi lactici*, as acid former, or another longer, staff-like bacterium, which I have found present in many places in our country. . . . I have obtained flavor by the application of either of these bacteria in connection with one of the yeast fungi previously described as producing both alcohol and lactic acid in milk (*Saccharomyces lactis* and *S. acidi lactici*). . . . It must finally be emphasized, in speaking of pure cultures as fermentation starters for ripening cream, that in the majority of cases it will hardly pay for the trouble of applying such if the cream to be ripened be not previously pasteurized."

American dairying, H. B. GURLER (*Chicago: J. H. Sanders Publishing Co., 1894, pp. 267, figs. 70*).—This is a practical treatise on dairy farming and creamery management by a practical and very successful dairyman and creamery manager. In addition to his practical knowledge on dairying the author shows himself to be familiar with the work in this line of the agricultural experiment stations in this country, and quotes freely from their publications.

Under the head of private dairying are treated the selection and breeding of the dairy herd; feeding and management; care of dairy utensils; milking; treatment of the milk from the cow to the cream vat; ripening and churning; salting, working, packing, printing, and marketing butter; and the use of skim milk.

Under creamery management, the care of milk by patrons; receiving milk at the creamery; the Babcock milk test; tempering and separating; ripening and churning cream; salting, working, packing, and marketing butter; the care of skim milk; and the care of buildings and utensils are treated, and suggestions are given to those about to build a creamery; remarks on the work of cream-gathering creameries; a talk with creamery employees, and a description of the testing of cream by means of alkaline tablets, as suggested by Farrington. The chapter on the Babcock milk test is by E. H. Farrington.

Trials of the Flensburger separator, H. HÖFT (*Molk. Ztg., 8 (1894), No. 34, pp. 516, 517, fig. 1*).

Dairy school and experiment station at Mamirolle (France), E. MARCHAL (*Bul. Min. Agr. Belgique, 10 (1894), No. 1, pp. 556, fig. 7*).—Notes on the dairy industry in three departments in eastern France, curriculum of the school, and results of investigations made by the experiment station.

TECHNOLOGY.

The potato starch industry, E. WIGGIN (*Amer. Agr. (middle ed.), 54 (1894), No. 4, pp. 89, 90, fig. 1*).

Cause of and means for the prevention of foaming in sugar manufacture, H. C. P. GEERLIGS (*West Java Sugar Sta. Contr. 12, pp. 1–9*).

The use of sulphuric acid in sugar manufacture, H. C. P. GEERLIGS (*West Java Sugar Sta. Contr. 12, pp. 15–20*).

The effect of lime and baryta on glucose, and their use in practice, H. C. P. GEERLIGS (*Repr. from Arch. Java Suikerind., 1893, pp. 16*).

Palm sugar, H. C. P. GEERLIGS (*Repr. from Arch. Java Suikerind., 1893, pp. 18, 19*).

The production of cane sugar from sugar cane, H. WINTER (*West Java Sugar Sta. Contr. 1, pp. 40–49*).

Clearing of glucose containing sap by the use of neutral or basic acetate of lead, H. C. P. GEERLIGS (*West Java Sugar Sta. Contr. 12, pp. 9–15*).

The separation of sirups, H. C. P. GEERLIGS (*Repr. from Arch. Java Suikerind., 1893, pp. 4–6*).

Investigations on alcoholic fermentation (*Abs. in Bot. Ztg., 52 (1894), II, No. 17, pp. 157–168*).

Some characteristics of California wines, W. H. KRUG (*Jour. Amer. Chem. Soc., 16 (1894), No. 9, pp. 597–617*).

The conservation of wine in its bearing on the public health, A. BIZZARRI (*Florence: Egisto Bruscoli, 1894*).

Extraction of Agave americana fiber, E. THURSTON (*Dept. Land Records and Agr., Madras, 1894, Bul. 30, pp. 295, 296*).—Brief notes on the growth of *Agave americana* and extraction of its fiber.

Tanning qualities of cañaigre, D. B. MASON (*U. S. Consular Rpt. 1894, Aug., pp. 642, 643*).—A brief statement of the uses to which canaigre is especially adapted.

Extracting perfume from flowers, B. G. HARDY (*Agl. Gaz. N. S. W., 5 (1894), No. 7, pp. 475–478*).—A report on experiments with extracting perfume by the enfleurage and maceration methods, with notes on the result from *Bouvardia*, tuberoses, various roses, carnations, phlox, spikehead, and other flowers.

AGRICULTURAL ENGINEERING.

The reclamation of arid land, A. A. JOHNSON (*Wyoming Sta. Bul. 18, pp. 47–65*).—The fundamental principles involved in a correct solution of the problem of reclaiming the arid lands are stated, present land laws as related to the subject are criticised, and methods proposed both in this country and in Australia are discussed.

"(1) It seems quite clear from all the facts under consideration that if the Federal land laws are to remain unchanged and the United States is to remain the owner of the large bodies of public lands in the arid region, then their reclamation must be undertaken by the National Government, for private capital will not enter upon this work under the conditions now prevalent and imposed by the present Federal land laws.

"(2) While the United States retains control over the public lands in the arid region it is impossible for the States to adopt the communal principle of Victoria, or the irrigation district system of California.

"(3) It therefore follows that the arid region of the West must remain undeveloped and uninhabited unless the arid lands are ceded to the respective States, so that each State may work out its own destiny under wise legislation."

Corn husker and fodder cutter, D. O. NOURSE (*Virginia Sta. Bul. 33, pp. 129–134, figs. 3*).—A discussion of the value of corn stover, with an illustrated description of a corn husker and fodder cutter. On the station farm this machine pulled and husked 20 to 24 bu. of corn per hour while cutting or shedding the fodder from the same. The appearance of the corn was better than when husked by hand.

State aid to road building in New Jersey, E. BURROUGH (*U. S. Dept. Agr., Office of Road Inquiry Bul. 9, p. 20*).—This is a paper prepared at the request of R. Stone, special agent and engineer in charge of the Office of Road Inquiry, to which is appended "numerous letters from farmers giving their experience with improved and unimproved roads." New Jersey is the only State which has provided for State aid to road building in the different counties. The salient feature of the law under which this is done is given in the bulletin.

"Under this act the property-owners pay one tenth and the State one third of the costs. These payments are virtually a free gift to the county, which pays the remainder and thereafter must keep the road in repair, thus compelling the citizens of cities and towns to bear the same burden that is imposed upon the farmers. It differs from the Union County road law (county-bonding law) in this respect: The latter compels the townships where the road is located to pay one third the cost and then to be taxed in common besides, thus making a double tax upon all the inhabitants of the township. The State aid law relieves them from this and imposes an assessment only on those whose property is benefited, without relieving them from local or county taxation; or, in other words, they are taxed in all respects the same as other citizens of the township are taxed, the extra assessment being a free-will offering for the benefits received. . . .

"The provisions of the law and the manner in which it has been enforced have proved satisfactory to the people of the localities where the improvements are located, and to others who have witnessed the practical benefits arising therefrom. The rapidity with which this sentiment has increased is apparent in the demands from more than half the counties in the State, from which specifications now on file represent enough miles of roads seeking recognition under the law to absorb the present annual State allowance for 2 years in advance of the present. The demand still continues, and will continue as it becomes practically demonstrated that all parts of the State are accessible to the operations of the law."

The Harvey water motor, A. A. JOHNSON (*Wyoming Sta. Bul. 18, pp. 66–72, figs. 6*).—This motor is essentially a combination of an undershot and a breast wheel connected with a pump and utilizing the power of the fall in the riffles in the Platte River. An illustrated description, taken largely from an article in *Irrigation Age*, 1894, June, is given. The motor is believed to be "a cheap, reliable, and effective method of taking water out of large streams for irrigation."

Depth and capacity of drains, I. P. ROBERTS (*Cult. and Country Gent., 1894, Oct. 11, p. 735*).

Irrigation—ways and means, I, L. R. TAFT (*Amer. Gard., 15 (1894), No. 23, pp. 397, 398*).—A series of articles on the main features of irrigation by windmills, etc.

Subirrigation, L. R. TAFT (*Drainage Jour., 16 (1894), No. 10, p. 272*).—Information as to size and construction of reservoirs, tile, etc.

Pump irrigation in Kansas (*Rural New Yorker, 1894, Sept. 8, pp. 566, 567, fig. 1*).—Popular accounts of successful attempts at individual irrigation, using pumps and windmills; also editorial comments.

A sugar-beet harvester, PYRO (*Abs. in Jour. Assoc. Anc. Élèv. Gembloux, 4 (1894), No. 11, pp. 400–404, figs. 2*).

Crushing machines for potatoes, II, RINGLEMANN (*Jour. Agr. Prat., 58 (1894), No. 38, pp. 422–425, figs. 5*).

STATISTICS.

Annual Report of Arizona Station, 1892 (*Univ. of Arizona Rpt. 1892, pp. 35–37, 42–48, 51–54, 56, 64–66, 73–76*).—Short reports by the director and heads of the various departments of the station, the treasurer's report for the fiscal year ending June 30, 1892, inventory of station property, and text of the Hatch Act.

Report of treasurer of Arizona Station (*Rpt. Bd. Regents, Univ. of Arizona, 1894, pp. 11*).—This is for the fiscal year ending June 30, 1893.

Annual Report of Colorado Station (*Colorado Sta. Rpt. 1893, pp. 82*).—This report consists of a review of the work of the several departments and substations, together with the treasurer's report for the fiscal year ending June 30, 1893.

Annual Report of Kansas Station (*Kansas Sta. Rpt. 1893, pp. 22*).—This includes a financial report for the year ending June 30, 1893, an outline of the bulletins published during the year, a list of previous publications, brief remarks on the work of

the departments of the station, meteorological summary (see p. 281), and an index to the bulletins of the year.

Reports of director and of treasurer of Kentucky Station, 1891, 1892, and 1893 (*Kentucky Sta. Rpts. 1891, pp. 6–8; 1892, pp. 6–8; and 1893, pp. 1–9*).—Financial statements for the fiscal years ending June 30, 1891, 1892, and 1893, respectively, and brief general remarks by the director.

Reports of director and of treasurer of Massachusetts State Station (*Massachusetts State Sta. Rpt. 1893, pp. 7–10, 396*).—A brief review of the work of the year, and a financial statement for the year ending December 20, 1893.

Annual Report of Nevada Station (*Nevada Sta. Rpt. 1893, pp. 34*).—This includes brief reports by the director and the heads of the several departments of the station, together with the treasurer's report for the fiscal year ending June 30, 1893.

Annual Report of New Mexico Station (*New Mexico Sta. Rpt. 1892–'93, pp. 17*).—This includes a brief review of the work of the year, and the treasurer's report for the fiscal year ending June 30, 1893.

Report of treasurer of South Carolina Station (*Clemson Agricultural College Rpt. 1893, p. 10*).—This is for the fiscal year ending June 30, 1893.

Report of the statistician (*U. S. Dept. Agr., Division of Statistics Rpt. 117, n. ser., pp. 395–444*).—Crop report for July, production of fruit by States, notes on the wool clip of the present year, the crops of Ontario and Manitoba and of European countries, the wheat crop of India for 1894, and transportation rates.

Report of the statistician (*U. S. Dept. Agr., Division of Statistics Rpt. 118, n. ser., pp. 445–536.*)—Crop report for August, notes on foreign agriculture, the production and consumption of rice in the United States, commerce between the United States and Mexico for the years 1873, 1878, 1883, 1888, and 1893, and transportation rates. Special attention is called to the use of improved machinery in rice culture in Louisiana, by which the cost of production is largely reduced.

Report of experimental gardens for 1892–'93, J. D. Kobus (*East Java Expt. Sta. Contr. 3, n. ser., pp. 27*).

Eighth annual report East Java Experiment Station for year ending April 13, 1894 (*East Java Expt. Sta. Contr. 9, n. ser., pp. 25*).

The agriculture of Chile, F. Neger (*Fühling's landw. Ztg., 43 (1894), No. 17, pp. 542–545*).—A popular article on crops, plant diseases, and weeds.

Vegetable resources of India (*Kew Misc. Bul. 93, pp. 315–328*).—A report on food, crops, oil seeds, fibers, dyeing and tanning material, drugs, and miscellaneous products.

Agricultural statistics of Costa Rica for 1893, E. Villavicencio (*An. Estad. Repub. Costa Rica, 1893*).

NOTES.

Arizona Station.—R. H. Forbes has been appointed chemist in the university and station and began his duties September 1.

Connecticut State Station.—The station is putting up a small forcing house for studying the uses of commercial fertilizers in winter forcing of vegetables.

Kentucky Station.—New vegetable forcing and propagating houses have been erected during the fall for the horticultural department of the station. They consist of two even-span houses, each 20 by 50 feet, one for tomatoes, cucumbers, etc., the other for plants requiring a cooler temperature; a 25 by 10 lean-to for propagating purposes connecting the two first mentioned; and a frame building communicating with all the others, which contains office and seed room, potting room, tool room, and a sleeping room for gardener. The latest and most approved methods of construction have been followed. The houses are heated by the hot-water system, and benches arranged for subirrigation. These additions give a much-needed and excellent equipment for experimental work along the lines of vegetable forcing and propagating.

Michigan Station.—C. D. Smith, professor of agriculture, has been made also director of the station.

New Mexico Station.—The following changes in the station staff have been made: S. P. McCrea succeeds H. Hadley as director; F. O. Kihlberg and H. H. Griffin have been appointed superintendents of the substations at Las Vegas and Aztec, respectively; and F. Garcia succeeds the latter as assistant agriculturist and horticulturist at the station.

Oregon Station.—G. W. Shaw, for the past four years professor of chemistry in the college, and from 1890 to 1892 chemist of the station, has again been elected to the latter position. J. Fulton has been appointed assistant chemist.

Pennsylvania Station.—H. Hayward, B. S., graduate of the course in agriculture at Cornell University in the class of 1894, has been appointed instructor in dairying in the college and assistant agriculturist of the station, *vice* W. H. Caldwell, resigned.

Personal mention.—Nathaniel Pringsheim, since 1857 editor of *Jahrbuch für wissenschaftliche Botanik*, died September 6, in his seventy-first year.

EXPERIMENT STATION RECORD.

VOL. VI. No. 5.

has been of late considerable controversy among feeders in this and in Europe as to the reliability of the feeding standards sed by Prof. Emil Wolff. In Europe it has been contended that a rule they are too low in protein and lower than the results obtained in practice justify. In this country they have been frequently criticized as being too high in protein, and the data collected indicate that they call for rather more protein than farmers and successful feeders are in the habit of feeding. It may be that the conditions of this country favor the feeding of a wider ration, giving more carbohydrates and fat, as these materials are relatively cheap and easily obtained. Wolff's standards were suggested twenty-five or more years ago, when there were fewer data at command than now. They may need revising and modifying to suit our conditions, and this presents a useful field of work for the experiment stations. It would seem, indeed, that the record of the feeding experiments already made by the stations should furnish much information upon this point. There is, however, a lack of systematic work along this line, and the results are frequently not comparable. The amount of reliable data on which to base a series of American feeding standards is comparatively small. In many cases the plan of the experiment either does not admit of inferences on this point, or the amounts of digestible nutrients are not calculated, and could not be calculated with accuracy from the data reported. Too often the experiments are merely a superficial comparison of this feeding stuff with that without a consideration of the actual amounts of digestible nutrients fed in each case. In such cases the results remain simply a comparison of the feeding stuffs in question, without furnishing any real contribution to the science of feeding. The opportunity is lost of combining the scientific with the purely practical. The intelligent farmer is given little which he could not have found out, perhaps equally well, for himself, instead of being given the result of scientific research along with the practical outcome of the experiment. It is a mistake to assume that in order to get results of practical value to the farmer the feeding methods of the farmer must be imitated.

Recently an experiment with cows was reported in which, using a constant basal ration, the effect of various coarse materials on the milk was studied. The nutritive ration of the basal ration was about 1:9.87 and was not materially improved by the feeding stuffs added in differ-

ent periods. The author admits that the rations are wide but defends this on the ground that "so are those of most . . . farmers who feed what they grow. We must feed as other farmers feed, or as they can conveniently feed, otherwise we suggest nothing to them." There could not well be a greater fallacy or one more detrimental to the greatest usefulness of the experiment stations. A science can not be developed by following common practice. The experiments made should embody in plan the best scientific knowledge of the time. An experiment may have a practical application without being carried out along practical lines, and if the conclusions arrived at have been obtained in a thorough scientific manner there is added safety in recommending them in practice. Is the effect on the milk of the coarse fodders tested more apparent or conclusive when they are fed in such out-of-balance rations? On the contrary, it is probably less so. Instead of perpetuating and encouraging a bad practice by recognizing and following it the station should try to improve it by example and teachings.

Recently two stations have studied the rations fed to cows by practical dairymen. The methods of work followed have been quite different, as has also the application of the results.

In the first case the attempt was made to tabulate the practice of dairymen in different parts of the country with a view to fixing a feeding standard for dairy cows. The data as to the amounts and kinds of food fed were solicited by a circular letter, and from the returns the amounts of digestible nutrients were calculated from average figures for composition and digestibility. In this way 128 rations were collected from 24 States and Canada, and these are averaged, giving what is termed the "American standard ration for dairy cows." This "standard" is recommended to American dairymen as being "the result of American feeding experience;" and the author is confident "that in the large majority of cases its adoption will give satisfactory results, and that it is preferable to the German standard ration so long placed before our stock feeders as the ideal one."

The average ration arrived at in the above manner represents merely the average practice of the correspondents filling out the blanks, nothing more. It does not represent the average practice in the United States even, for far more data would be needed than has yet been collected to calculate the average practice of successful dairymen in this country with anything like certainty. Even then the result would be only an *average*, not a *standard*. A feeding standard is an expression of the amount and proportion of the several nutrients best adapted to the purpose for which the animal is kept, as determined by continued and systematic feeding experiments conducted on scientific principles. Its value depends upon the extent and accuracy of the observations on which it is based. A feeding standard can not be established by a study of feeding practice. In the first place there are serious difficul-

ties in the way of obtaining reliable returns through correspondence. The data thus collected are to a large extent rough approximations, often given with more or less indifference as to exact accuracy. In the case cited above it is stated that considerable difficulty was encountered in getting correspondents to make full returns, and often three letters had to be sent before the necessary data could be secured. In the second place, it is by no means certain that the practice of these correspondents, even if representative, is the best. It may be the best financially for the individual cases, but even that can hardly be assumed to be true. The individuals are governed very largely by the feeding stuffs at their command and the market prices, rather than by any scientific consideration. If their practice were sufficiently perfect the necessity for experiments in feeding would be at an end. But there are good reasons for believing it is not, especially when the collection of data from different parts of the country shows that the daily ration of protein, for instance, ranges all the way from 1.36 to 3.20 lbs. per cow. The cow does not demand more protein in Utah than in Illinois. Both amounts may be profitable, but both can not represent the amount best adapted for cows throughout the country—the amount which the average cow requires to give the best result from her food. Surely there can be no safety in such averages. It is a mere accident if the result is not misleading. It is certainly working in the wrong direction.

In the case of the other station referred to, a representative of the station was sent to each farm where observations were made and remained there 5 to 12 days, weighing the feed given each cow and taking samples for analysis, weighing and testing the milk, and making a record of the breed, weight, and stage of the milking period of each cow. Any portions of the food left uneaten were weighed and allowance made for them. The feeding stuffs were all analyzed at the station, and the rations calculated. Suggestions were then made to the farmers for improving their rations, which usually resulted in cheapening them. Several of the farmers have adopted these changes with marked advantage. Twenty-two such studies were made during two seasons. In conclusion, a tentative ration is suggested which, however, is considerably lower in fat and carbohydrates than the average of the rations studied, although it is believed the latter represent methods of feeding above the average for the State.

It is stated that this is only a beginning of coöperation of the station directly with dairymen in the study of the methods of feeding their cows and the ways by which improvements may be made. There seems reason for hoping that studies of this kind may prove as valuable an educational feature as the coöperative fertilizer experiments.

The collection of statistics on the practice of feeding may be suggestive and useful in its way, but the error should not be made of supposing that a standard can be worked out in this manner. Thorough systematic feeding experiments by scientific experts alone can

furnish the proper basis for American feeding standards. The experiments should be made in different parts of the country and continued through a number of years. They should be planned on a system which will make the results properly comparable, and the records should be accurately kept. Summaries of data obtained in this way, and of the available data which we have now, would be fairly entitled to be called feeding standards. These standards would have a real value because they would be founded on scientific work and deductions. The closeness with which they would be followed by farmers in different parts of the country would, of course, depend on a number of variable conditions, as must be the case with any standard. With the further accumulation of feeding experiments, the standards would probably have to be somewhat modified and perfected.

Wolff has at least given us something to work upon. We should profit by his mistakes, but we should not abandon the attempt to perfect the science of feeding.

NITRIFICATION IN ARABLE SOIL.

P. P. DEHÉRAIN.

THE EFFICACY OF NITRATES.

In 1856 Boussingault and Georges Ville almost at the same time clearly observed the marked effect which nitrates exert on the development of plants.[1] The experiments of Boussingault were particularly convincing. He prepared a sterile soil of sand and gravel, to which he added the mineral substances necessary to plant growth and planted sunflower seeds in it. In case of those receiving mineral fertilizers alone the young plants after drying weighed only 0.507 gm. They attained a weight of 0.88 gm. when the sand on which they grew received 0.02 gm. of nitrate, 1.24 gm. when 0.04 gm. nitrate was applied, and 3.39 gm. when the amount of nitrate was increased to 0.16 gm.

More recently Hellriegel has continued experiments in this line on barley. The yield of dry matter varied from 0.415 to 0.508 gm. when the sand in which the barley was planted received no nitrate of lime. It increased as the quantity of nitrate of lime applied increased, reaching 10.805 gm. when 0.656 gm. of nitrate was applied, 16.388 gm. with 0.984 gm., and finally 29.343 gm. with 1.968 gm. of nitrate.

It is hardly necessary to point out that Europe imports annually 500,000 tons[2] of nitrate of soda, which is brought from the deposits along the coast of the Pacific in Peru, Bolivia, and Chile. Evidently this industry would not assume such large proportions if the great value of nitrate in agriculture was not appreciated.

In France at the present time the growers of beets always supplement the regular application of 20 to 40 tons of barnyard manure per hectare with 150 to 200 kg. of nitrate of soda.

It is not without surprise that we note the necessity for this constant application of nitrogenous fertilizers; for, as Liebig pointed out more than 50 years ago, ordinary soils contain considerable amounts of nitrogen, not infrequently 1 to 2 parts per thousand. If we assume that the roots of our ordinary plants go down only to a depth of 35

[1] In the seventeenth century certain observations had been made on this subject. Dygbe had observed that saltpeter exerted marked influence on the growth of hemp. Also in 1851 the Prince de Salm Horstmar observed that nitrates favored the growth of oats.

[2] The metric ton used here and elsewhere in this article is equal to 2,204.6 lbs.

cm., and they frequently exceed this depth, it is estimated that the soil of 1 hectare (within the reach of the roots of plants) weighs about 4,000 tons and contains 4,000 to 8,000 kg. of combined nitrogen. When we remember that good crops of beets or of grain require only from 100 to 120 kg. of nitrogen, it is a matter of surprise that these crops will not thrive unless there is annually added to this enormous stock of combined nitrogen 150 to 200 kg. of nitrate of soda containing from 22 to 30 kg. of nitrogen.

It is clear that the nitrogen is held in the soil in stable combinations which resist the action of air and water and do not furnish sufficient food to plants at certain stages of growth when they most need it. Furthermore, the conditions of culture are very different from those which obtain in connection with spontaneous vegetation. The flora of a meadow, for instance, is composed of different species which arrive at maturity at successive periods. It is entirely different, however, in ordinary field culture. In the latter there is grown on the soil a large number of plants of the same species seeded at the same time and passing through different phases of growth together and all having the same needs at the same time. The transformation of the organic nitrogenous material of the soil is not sufficiently rapid or is not sufficiently complete in time to supply their needs, and hence the use of nitrogenous fertilizers is rendered necessary. This is more particularly necessary because we do not know how to hasten the transformation of the nitrogen of humus during spring and early summer into those forms which are assimilated and utilized by plants.

Under what influences are these transformations brought about? To what agencies are they due? Is it possible by means of these agencies to utilize the enormous reserves of combined nitrogen which humus soils contain? These are the questions which it is proposed to discuss in this article.

ASSIMILATION OF AMMONIA—TRANSFORMATION OF THE NITROGEN OF HUMUS INTO AMMONIA.

According to the work of Boussingault and Ville it would appear that nitrogen is not assimilated in the form of ammonia. The numerous experiments of Schattenmann in Alsace, of Kuhlmann in the Department of Nord, and of Lawes and Gilbert at Rothamsted, England, have demonstrated the effectiveness of ammonia salts as fertilizers. Recent observations have rendered untenable the opinion, based on the ready assimilability of nitrates and the rapid nitrification of ammonia in the soil, and held until within a few years by certain agriculturists, that plants utilize ammonia only after its oxidation and transformation to nitrates. Müntz, of the Agricultural Institute of Paris, has demonstrated the falsity of this view. He grew plants in a soil deprived of nitrates by prolonged leaching and freed from nitrifying ferments by the action of heat. He also took special precautions to prevent the

introduction of these ferments during the course of the experiment. The plants were inclosed in glass vessels, and the air supplied to them was conducted through glycerin in order to remove all dust which might carry in the nitrifying germs. Under these conditions corn, beans, barley, horse beans, and hemp attained a normal development in a soil in which no nitrates were present, and their growth can only be attributed to the influence of the ammonia salts used as a fertilizer.

Bréal, of the Laboratory of Vegetable Physiology of the Museum of Paris, has recently reported a very simple method of demonstrating the assimilation of ammonia salts. He took from a meadow a tuft of *Poa annua*, washed the roots carefully, and placed it in water in a flask of dark glass or one which was wrapped with paper in order to prevent the growth of algæ. After a few days the grass developed new white roots, which were covered with abundant root hairs. The old roots were cut off and sufficient mineral matter for the development of the roots was introduced into the water in the flask along with a certain amount of ammonia salt. At the beginning the solution gave a strong reaction with Nessler's reagent, but after 24 hours this reagent did not indicate the presence of ammonia.[1] In this case the plant thrived in a solution containing 1 part in 10,000 of sulphate of ammonia.

In view of the fact that ammonia introduced into the soil is readily transformed into nitrates, it may be maintained that these experiments are only of physiological interest, and that since ammonia resulting from the decomposition of nitrogenous organic matter of the soil passes rapidly to the state of nitrates, the question of principal importance is to know how the ammonia is produced. The subject of the assimilation of ammonia compounds assumes greater importance, however, when we remember that nitrates are found in the soil of neither meadows nor forests, and that undoubtedly plants which grow on these soils derive their nitrogen from ammonia.

Certain of the decomposition products of the nitrogenous substances of the soil appear to have a composition analogous to that of the amids. Their decomposition under the influence of chemical forces at 100° C. and above is limited by the presence of ammonia salts, as determined by the laws of dissociation.[2] In the soil at ordinary temperatures nitrogenous materials are transformed by fermentation.

For the investigation of this subject Müntz and Coudon prepared 2 lots of the same soil as nearly alike as possible. One was allowed to remain at ordinary temperatures, the other was heated to 120° C. for several hours to sterilize it. The 2 samples were exposed to the air under like conditions, after having the ammonia in them determined. After 42 hours the lot which had not been heated had formed 18.1 parts per 1,000 of ammonia; after 105 hours the quantity had increased to 50.4 parts; while during the same period the amount of ammonia remained

[1] Ann. Agron., 19, p. 279.

[2] A. Hébert, Ann. Agron., 15, p. 355.

stationary in the lot of soil which had been sterilized.[1] It should be observed here that the ferments which bring about the transformation of nitrogenous matter into ammonia are very resistant, and that if they are subjected to 100° for only a short time they are not completely destroyed. It is necessary to subject them to a temperature of 120° for several hours in order to completely check their activity.

Müntz and Coudon have isolated and cultivated several of the microörganisms of the soil and have found that almost all of them possess the property of forming ammonia. The organisms which bring about this transformation are very numerous and belong to widely separated species, being found not only among the molds but also among the bacilli and micrococci. Ammoniacal fermentation is not due, therefore, to a particular species, but is a function possessed in common by a large number of species. A young Belgian agriculturist, E. Marchal, has suggested that in arable soils the action of bacteria is predominant, while in humus soils of an acid reaction, such as those of meadows, the formation of ammonia is due in large part to the molds.[2]

In very moist soils highly charged with humus, where the air circulates with difficulty, ammonia predominates and serves as plant food, but in well cultivated soils thoroughly aërated the transformation to nitric nitrogen is very rapid and complete. The different phases of this transformation will be discussed in the following pages.

FORMATION OF NITRATES IN THE SOIL—DISCOVERY OF THE NITRIC FERMENT.

It was held for a long time that nitrification of ammonia was due simply to chemical action. A celebrated experiment by the well-known chemist Kuhlmann served to confirm this erroneous view. He observed that when a current of air charged with ammonia was conducted over spongy platinum, or better, platinum black, gently heated, the ammonia was burned, its hydrogen forming water and its nitrogen nitrous vapors.

This experiment led to extravagant generalizations. It was held that when saltpeter appeared on the walls of stables or sheepfolds, or in the soil of a cave, it was due to ammonia which had been burned by oxygen under the influence of a porous body acting in the same manner as the platinum black. The porous body to which was attributed the property of favoring the combustion was supposed to be the rough walls or the soil. This view was held until 1862, when Pasteur observed that almost all slow combustions are brought about by microörganisms. Alcohol, for example, is not transformed by oxidation into acetic acid in the process of vinegar-making until the surface of the liquid to be acetified is covered by a thin veil of the white mold (*Mycoderma aceti*). Should not the oxidation of ammonia and its transforma-

[1] Ann. Agron., 19, p. 209. [2] Ann. Agron., 19, p. 506.

tion into nitric acid be also attributed to the action of a ferment? Pasteur urged the propriety of studying nitrification at this time.

This was done by Boussingault in 1873.[1] In order to investigate the theory of Kuhlmann that all that was necessary for the oxidation of ammonia was the presence of air and a porous body, Boussingault introduced into various porous materials, such as sand, chalk, and soil, readily nitrifiable nitrogenous substances, kept the mixture moist and well aërated in order to favor nitrification, and after a certain time determined the nitrates formed. In the sand and the chalk the nitrogenous materials did not undergo any transformation. In the soil, on the contrary, metamorphosis was rapid; *i. e.*, nitrates did not appear in the first two porous substances, but were abundant in the last. What, therefore, did the soil contain which was lacking in the sand or the chalk? Boussingault did not attempt to find out. He was familiar, however, with the opinions of Pasteur, for he discussed the influence on the oxidation of ammonia of microörganisms, which he styled "the fungi of Pasteur."

It was not until 3 years later that the cause of this special action of the soil was discovered by Schlösing and Müntz in the course of experiments relating to the purification of sewage water by filtration through soil. In these experiments large cylinders, 2 meters high, filled with soil, received the sewage under treatment. When the water filtered slowly through the soil it was found that not only the solid materials which were in suspension were removed, but also that the dissolved substances were greatly modified. Although the original solution contained ammonia salts derived from the fermentation of the sewage, the filtered water contained no ammonia, but was charged with nitrates. This observation simply confirmed those of Boussingault on the influence of soil on nitrification, and would hardly be worth describing if it had not been the first step toward the important discovery which has made the names of Schlösing and Müntz illustrious.

Some time before this Müntz had made the observation that chloroform acts on all animal organisms, and especially that it benumbs and paralyzes the activity of ferments. Profiting by this interesting observation Schlösing and Müntz introduced into a cylinder used for filtering sewage water a certain amount of chloroform, and afterwards examined day by day the water which filtered through the soil. This water was limpid from the first, but very soon the nitrates diminished and finally disappeared, *i. e.*, the chloroform completely checked nitrification. Since chloroform acts only on living beings, it is evident that if the chloroforming of the soil caused it to lose its nitrifying properties nitrification must have been due, as Pasteur maintained, to a true fermentation. It is possible to confirm this conclusion by other tests. The microörganisms are destroyed by temperatures of 100 to 120° C. In other words, a soil loses its nitrifying properties when it is sterilized or has all living organisms in it destroyed. If, however,

[1] Ann. Chim. Phys., 29, ser. 4, p. 186.

a soil sterilized at 120° is inoculated with a soil which has not been heated, the nitrifying organisms renew their activity and nitrates reappear.

When we remember that the nitrogenous matter of the soil is inert, and that generally it exercises no perceptible effect on vegetation, and if we recall, on the contrary, that nitrates possess such efficacy that the yield obtained in a sterile soil increases in proportion to the weight of nitrate added, we can understand the importance of the discovery of Schlösing and Müntz and the new ideas which it suggests to agriculturists, for to the latter henceforth a fertile soil is to be looked upon as essentially a culture medium for nitric ferments.

The existence of ferments deduced from the preceding observations was known a dozen years before an attempt was made to isolate the specific organisms. These were first studied by an eminent Russian physiologist, Winogradsky. After numerous experiments, manifesting great skill and patience, Winogradsky succeeded in isolating the nitrous ferment, *i. e.*, the living organism which carries forward the oxidation of ammonia 1°. Five or six days after inoculating a liquid which contained per liter 1 gm. of sulphate of ammonia, 1 gm. of phosphate of potash, and a little carbonate of magnesia without any organic matter, Winogradsky observed a slight cloudiness in the solution, due to somewhat fusiform oval organisms, moving in the liquid with great activity. This activity, however, was not of long duration, for after a short time the organisms dropped to the bottom of the liquid and covered the carbonate of magnesia with a slimy secretion.

It is interesting to observe that Winogradsky succeeded in growing the nitromonas in a medium free from organic matter and containing no carbon except that of the carbonic acid of the carbonate of magnesia. In order that the microörganisms might utilize this carbon in the formation of their tissues the carbonic acid was first set free and then the carbon separated from the oxygen, without the intervention of any exterior energy. This was accomplished by the heat generated by the combustion of the hydrogen of ammonia.

Winogradsky observed further that the transformation of ammonia into nitric acid was accomplished in two successive stages. The nitromonas described above gave only nitrous acid. The complete oxidation of nitrogen was due to another organism entirely different from the nitromonas. The organism which transforms the nitrous acid to nitric acid is a small irregular angular rod, which exercises the special function of superoxidation but is entirely incapable of oxidizing ammonia. This is a portion of the work of the highest interest.[1] When nitrates appear in a culture medium the medium contains two different microörganisms—the nitromonas, which transforms ammonia into nitrous acid, and the small rods, which transform nitrous acid into nitric acid.

[1] Ann. Inst. Pasteur, 4 (1890), pp. 213, 257, 760; 5 (1891), pp. 92, 577 (E. S. R., 2, p. 751; 3, p. 551); also Compt. Rend., 113 (1891), pp. 89–92 (E. S. R., 3, p, 550).

CONDITIONS NECESSARY TO THE PRODUCTION OF NITRATES IN THE SOIL.

The following are the more important conditions:

Aëration.—Manifestly nitrification is an oxidation and, therefore, requires that the soil should be uniformly aërated. If soil is placed in a closed flask provided with a tube for drawing off the gas produced, it will be observed after a certain time that the gas contains carbonic acid and nitrogen, and that the nitrates in the soil have disappeared (Schlösing). Maquenne and the author have observed that the reduction of nitrates in a nonaërated soil is due to an anaërobic ferment, which has been determined by Gayon and Dupetit. They observed, further, that the evolution of nitrogen, due to the decomposition of nitrates, was accompanied by formation of protoxid of nitrogen.

Humidity.—Schlösing observed more than 25 years ago that the quantity of nitrates formed in a soil increases with the humidity when this is not sufficient to wet the soil and interfere with the free passage of the air. A kilogram of soil which contains 9.3 per cent humidity produced in a month 157 mg. of nitric acid, and 470 mg. during the same time when the amount of moisture was 20 per cent.

Temperature.—Nitrification almost ceases at 5° C., and it begins very slowly in soils which have been frozen.

In the month of January, 1893, the author collected from experimental plats in the garden of the Museum of Paris samples of soil which were exposed to a gentle heat to thaw them. These were pulverized and sifted, and then exposed to the temperature of the laboratory, which rose to 15° during the day, but fell to 5 or 6° during the night. Nitrification was so slow that 3 weeks after the beginning of the experiment only 47 to 66 mg. of nitric nitrogen per kilogram was found, while only 14 days after the commencement of similar experiments on soils collected at the end of March 137 mg. of nitric nitrogen per kilogram was found in samples which were kept at ordinary temperatures, and 175 mg. in those maintained at 30° C.

According to Schlösing, the temperature most favorable to nitrification is about 35° C. At 55° the activity of the ferments is checked.

The presence of a salifiable base.—Boussingault long ago observed that forest soils do not contain nitrates, and recently Bréal has verified this observation by a very rapid and exact method. He placed in dishes filled with the soil to be examined small strips of filter paper, the lower ends of which reached to the bottom of the dishes and the upper ends extended above the soil. Sufficient water was added to make the soil moist. The water rose by capillarity in the strips of paper, drawing up any nitrates that might be present. After a few days he cut off the points of the strips and tested for nitrates in them by means of sulphate of diphenylamine, which, in presence of these salts, gives an intensely dark-blue coloration. The failure to obtain this coloration made it certain that the soil contained no nitrates.

The absence of nitrates is due to the acid reaction of a soil containing an excess of vegetable matter. The nitric ferment does not act in an acid medium, and this explains the great benefit derived from the use of calcareous manures. Müntz and Girard applied to a recently cleared soil of Brittany of an acid reaction dried blood, horn meal, or guano, but observed no formation of nitrates until the soils were marled.

It should be observed in this connection that while it is necessary to reduce the acidity an excess of soluble base is also injurious. The deleterious influence of caustic lime on nitrification was noted many years ago by Boussingault. The alkalinity of limewater, according to Warington, is much more than sufficient to check the production of nitric acid. Heavy liming of soil, therefore, suspends nitrification until the lime is converted into carbonate, but the final results will be favorable if the original soil is deficient in lime.

It is true that nitrification may go on in soil deficient in lime, but when the drainage water of such soils is examined it is found that the nitric acid is combined with potash and magnesia. Moreover, the application of carbonate of lime to such soils is very beneficial and increases the production of nitrates.

A soil from Guadeloupe gave 194 mg. of nitric nitrogen per liter without application, 353 mg. when it received 5 gm. of sulphate of ammonia, and 348 mg. when only 2 gm. of carbonate of lime was added. In other words, the introduction of a small amount of lime exercised as marked an effect on nitrification as a very strong application of readily nitrifiable material, such as sulphate of ammonia.

Presence of nitric ferments.—These appear to be very widely distributed. Müntz and Aubin have observed their presence not only in all cultivated soils which they have examined, but also in those of deserts and in those at high altitudes, such as the summit of Pic-du-Midi. Warington, who has studied the dissemination of the nitric ferment with much care,[1] found it abundant at the surface of all fertile soils, but more rare in samples taken from the lower layers of the soil. In a test commenced on November 17, 1883, no nitrifying organisms were found below 0.9 meter of the surface. In another test made on April 5, 1884, the organisms were abundant at a depth of 0.225 meter, but were not encountered at a depth of 0.375 meter. In brief, Warington, in 4 observations, made at depths of 50, 75, and 150 mm. below the surface, and in 4 experiments with culture solutions inoculated with a soil taken at a depth of 225 mm., invariably found a formation of nitrates. With the soil below 225 mm. the results were irregular, and indicated that in clay soils the nitrifying organisms are not distributed to a greater depth than 225 mm. below the surface. It is probable, however, that they may be encountered at a much greater depth in channels formed by roots; and without doubt in sandy soils they go much deeper than in clay soils.

[1] Jour. Chem. Soc. London, 45 (1886); abs. in Ann. Agron., 11, p. 49.

Koch[1] observed in the soils which he examined that microörganisms rapidly decreased in number as the depth at which the samples were taken increased.

Nitrifiable organic substances.—It will be readily understood *a priori* that all the nitrogenous substances which the soil contains naturally, or which have been introduced in the form of fertilizers, are not acted upon by nitrifying ferments with equal readiness. In soils cultivated without fertilizers the nitrifying material is humus, which, on account of the resistance it presents to the action of ferments, is abundant in certain soils and present in all, since no soil bearing vegetation is absolutely devoid of nitrogenous matter. This resistance to nitrification, however, is not absolute, and it is interesting to study to what extent the microörganisms overcome it. During recent years the author has devoted much time and study to the investigation of the formation of nitrates in soils from different sources and in different states of fertility,[2] and since barnyard manure is to-day more largely employed than any other fertilizer in the majority of farm operations, the author has also investigated to what extent the nitrogenous matter supplied by it to the soil is transformed into the highly assimilable nitrates.

Nitrates readily filter through the soil, and are so completely removed in the drainage that a study of the drainage water affords an accurate measure of the activity of nitrification in a soil. The leaching of a soil by rain water is by no means as complete as that obtained in the laboratory on small quantities of soil. Nevertheless, analysis of the drainage water of soil without vegetation carried on throughout the year shows such small quantities of nitrates during winter that it appears certain that the rain water removes practically all the nitrates formed during the more favorable seasons. Furthermore, by allowing the experimental soils to be exposed to rain, sun, and cold, and collecting the water which passes through, we undoubtedly obtain more precise information regarding nitrification in soils in place than can be procured by studies in the laboratory. It is by examining the drainage water thus obtained that the author has studied nitrification in arable soils.

STUDY OF DRAINAGE WATERS—METHODS OF RESEARCH.

In these investigations 2 methods were followed. At first pots were used, but afterwards these were discarded for vegetation boxes. The first were large, slightly conical pots, of glazed earthenware, standing on iron tripods. The holes in the bottom were fitted with tubes, through which the drainage water passed into large flasks placed beneath to receive it. Before filling with soil the bottoms of the pots were covered with a layer of gravel to facilitate drainage and prevent clogging of

[1] Jahresber. Agr. Chem., 81, p. 69.

[2] These researches have been published in Ann. Agron., 14–20.

the tube. At the beginning pots were used which contained only 30 kg. of soil, but these were soon replaced by others which held over 50 kg. In most cases these pots were arranged in a trench, and protected from direct radiation. Despite this precaution the soils were warmer and drier than those in place. Although the elevation of temperature favored nitrification and the drying impeded it, it is not to be supposed that these two opposite forces exactly counterbalanced each other, but it may be assumed that the results found did not vary much from those which would be found in soil in place in a climate warmer and a little drier than that of Paris.

This method of investigation has the advantages of requiring little space for installation, and of allowing almost indefinite multiplication of pots, with a large variety of soils; but while pots containing 50 kg. of soil gave good average yields of small plants, such as rye grass, clover, and even vetches, the larger plants—beets, wheat, and oats—did not thrive well in them. There was not sufficient room for the growth of roots. To overcome this objection vegetation boxes were devised which held as high as 5 tons of soil.

The first investigations to which attention will be called were made in pots, the last exclusively in the vegetation cases, which will be described when the results obtained in them are discussed.

COMPOSITION OF THE DRAINAGE WATERS OF MANURED AND UNMANURED SOILS.

The soils on which experiments were made were obtained from 4 different localities: From the experimental field of Grignon (Seine-et-Oise) in the vicinity of Paris; from Wardrecques on the boundary between Pas-de-Calais and Nord; from Marmilhat and Palbost (Puy-de-Dôme) in central France; and from Blaringhem in the Department of Nord.

The soil of the experimental grounds of Grignon is light, permeable, and sandy, and suffers more from drought than from excessive moisture. It rests on coarse, rotten limestone, and is not drained, because it does not need draining. The proportion of total nitrogen in this soil varies from 1.5 to 2 parts per 1,000. The soil of Wardrecques (Pas-de-Calais) is stronger than that of Grignon, being of excellent quality, but rests on impermeable clay, and is much benefited by being drained. In favorable seasons it yields enormous crops of wheat. Its proportion of nitrogen is the same as that of the Grignon soil. The soils of Marmilhat and Palbost are more clayey, and do not attain their full value until they are drained. They are also poor in nitrogen. They were collected in the plain known as the Limagne, which lies at the foot of the mountains of Auvergne. They are very rich in organic matter, have a characteristic black color, and generally contain over 2 parts per 1,000 of nitrogen.

The quantities of drainage water obtained from these soils, manured and unmanured, calculated to millimeters, are shown in the following table:

Drainage water from manured and unmanured soils without vegetation, March, 1891, to March, 1892.

Kind of soil.	Manured.	Unmanured.	Difference.
	Mm.	*Mm.*	*Mm.*
Experimental field of Grignon	315.3	277.3	+38.0
Wardrecques (Pas-de-Calais)	259.6	251.3	+ 8.3
Marmilhat (Puy-de-Dôme)	332.7	327.7	+ 5.0
Palbost (Puy-de-Dôme)	240.0	373.0	−33.8

The variations, favoring the manured soil in one case as much as they do the unmanured soil in another, indicate that the addition of barnyard manure did not exert an appreciable influence on the power of the soils to retain water.

The unmanured soils gave, from March, 1891, to March, 1892, the following quantities of nitric nitrogen.

Nitric nitrogen in drainage water.

	Kg. per hectare.
Grignon:	
A without manure; in grass since 1879	78.52
B cultivated; well manured	115.95
C cultivated; without manure since 1875	74.70
Wardrecques	73.80
Blaringhem	112.60
Marmilhat	62.06
Palbost	63.44

These figures are much higher than those obtained at Rothamsted. Warington found, in 1877 to 1886, 44 kg. of nitric nitrogen per hectare, annually, while our soils have furnished on an average 83.01 kg. We point out below the probable cause of this divergence. If the preceding figures are carefully compared it will be seen that light soils, such as that of Grignon, enriched by previous manuring, give a much greater quantity of nitrates than similar soils remaining for a long time without fertilizers. It will be observed, on the other hand, that in spite of the lack of recent manuring the organic matter of the soil in plat C, which had remained without fertilizers since 1875, still furnished considerable quantities of nitrates, a little more than that observed in Wardrecques and Limagne soils, but appreciably less than that found in the Blaringhem soil. In order to arrive at the extent of nitrification of the nitrogen of the manure, the surface area of the soil represented in two of the above experiments, one without manure and the other with 1 kg. of good barnyard manure, was determined, and from this the amount of barnyard manure applied per hectare was cal-

culated. This was found to be the very heavy application of 60,000 kg. per hectare. Both manured and unmanured soils were exposed to the rainfall during an entire year, March, 1891, to March, 1892, and the drainage water was collected and analyzed. The results in kilograms per hectare are shown in the following table:

Nitric nitrogen in the drainage water during different seasons, March, 1891, to March, 1892.

Soil.	Spring.	Summer.	Autumn.	Winter.	Whole year.
Grignon:	*Kg.*	*Kg.*	*Kg.*	*Kg.*	*Kg.*
Manured	78.88	39.84	58.84	21.30	198.86
Unmanured	36.42	15.84	47.00	16.69	115.95
Difference	42.46	24.00	11.84	4.61	82.91
Wardrecques:					
Manured	48.48	20.46	42.10	19.44	130.48
Unmanured	17.10	13.44	27.66	15.60	73.80
Difference	31.38	7.02	14.44	3.86	56.68
Marmilhat:					
Manured	44.52	22.92	34.20	19.92	121.56
Unmanured	15.84	16.80	17.28	12.14	62.06
Difference	28.68	6.12	16.92	7.78	59.50
Palbost:					
Manured	36.96	15.96	36.42	17.10	106.44
Unmanured	13.08	18.18	21.14	11.94	64.34
Difference	23.88	−2.22	15.28	5.16	42.10

The preceding figures are very high. As already stated, they greatly exceed those given by Lawes, Gilbert, and Warington for the drainage water of soils without vegetation.

If we compare the figures in the last column we find that the manure has nitrified at very different rates in the different soils. In the very permeable light soil of Grignon the total quantity of nitrogen nitrified, in both the manured and unmanured soil, was much higher than that in the strong soil of Wardrecques, or in the soils of the Limagne.

We observe, also, that the nitrification of the nitrogenous matter of the manure was more rapid in the spring than in summer, autumn, or winter. This is without doubt due to the fact that the nitric ferments act first on the ammonia of the manure, which is much more readily nitrifiable than the organic substances with which it is mixed. Nevertheless in all cases soils containing residues of previous manuring have manifested more active nitrification, as measured by the total quantity of nitric nitrogen obtained, than those which had not been manured.

In the preceding experiments nitrification has been very active, the manuring copious, and the figures obtained have been much higher than those yielded by soils in place. They may, therefore, be taken as the maximum of the amount of the nitrogen of manure which will be transformed into assimilable nitrates during the first year. If we com-

pare the quantity of nitrogen applied in the form of manure and the amount nitrified we have the following very instructive table:

Quantities of nitric nitrogen found in the drainage water at different seasons of the year, calculated to 100 parts of nitrogen applied in the form of manure.

Soil.	Spring.	Summer.	Autumn.	Winter.	Whole year.
	Kg.	*Kg.*	*Kg.*	*Kg.*	*Kg.*
Grignon	14.15	7.66	3.94	1.55	27.28
Wardrecques	10.46	2.34	4.81	1.24	18.85
Marmilhat	9.56	2.64	5.64	2.59	20.43
Palbost	7.96	0.10	5.12	2.05	15.13
Average	10.53	3.01	4.87	1.85	20.43

On an average one fifth of the nitrogen of manure was changed to the form of nitric nitrogen during the year and either utilized by the crops or lost. Of this total quantity 10 per cent was found in the drainage water in the spring, 5 per cent in autumn, and only 3 per cent in summer.

Even if we assume that soils in place, manured like the preceding, furnish a proportion of nitrates as high as those obtained in these experiments, we find that the amounts thus furnished are still insufficient and that in order to obtain high yields farmers are obliged to use nitrate of soda.

A good crop of beets requires about 100 kg. of assimilable nitrogen per hectare. All of the manured soils examined gave more than 100 kg. of nitrogen, and nitrification was sufficiently active at the beginning, as we have observed, to sustain a vigorous growth of beets. It must be observed in this connection, however, that the beets were seeded in April or May and attained full growth about the time of the heavy rains of autumn, so that only the nitrates formed during the spring and summer were utilized. Calculating the amounts thus obtained we have the following figures:

Nitrates available to a crop of beets during spring and summer.

	Kg. per hectare.
Grignon soil (manured)	118.72
Wardrecques (manured)	68.94
Marmilhat (manured)	67.44
Palbost (manured)	52.92

Although these soils were surrounded by the most favorable conditions, and nitrification in them was undoubtedly much more active than in soils in place, we find that three out of the four did not furnish, during the period of growth, the amount of nitrates necessary for the production of a good crop of beets.

This is a singular situation and merits careful consideration. The soils used in these experiments contained from 1.5 to 2 parts per 1,000 of nitrogen, or per hectare of 4,000 tons from 6,000 to 8,000 kg. of nitro-

gen, to which has been added 60 tons of manure per hectare, furnishing 300 kg. more of nitrogen, and yet they do not supply enough nitrates to support a full crop of beets; but we are obliged to send around Cape Horn to the Pacific coast to get nitrate of soda to reinforce the already considerable supply of nitrogenous matter in the soils.

We have at our disposal in cultivated soils enormous reserves of nitrogen in insoluble combinations. We know to-day that this nitrogen is transformed to an assimilable condition by microörganisms which have been isolated and studied and whose requirements and conditions of existence are understood.

Is it not possible to so increase the activity of these organisms that they will supply the nitric nitrogen required by our crops? This is the problem which we should attempt to solve.

RECENT WORK IN AGRICULTURAL SCIENCE.

CHEMISTRY.

Methods of fertilizer analysis proposed by the International Congress of Applied Chemistry at Brussels and Antwerp, 1894 (*Chem. Ztg., 18 (1894), No. 69, pp. 1322, 1323*).—*Analysis of nitrate of soda.*—Direct determination of nitrogen by the Schlösing-Grandeau method, or by some other quick, inexpensive, and sufficiently accurate method is recommended. The statement of the amount of sodium nitrate present should be based on a complete analysis, and the chemist should determine whether low contents of sodium nitrate are due to adulteration or to salts which naturally occur in commercial nitrate of soda.

Determination of phosphoric acid in general.—Small amounts of phosphoric acid should be determined by the molybdic method. For ordinary purposes the "citro-mechanical" (citric acid) method may be employed.

Determination of water-soluble and citrate-soluble phosphoric acid.—This subject was referred to an international commission for further study, but G. Masson proposed the following methods: For determining simply the soluble phosphoric acid in superphosphates 5 gm. of superphosphate is rubbed up in a glass mortar, first without moistening and then with 50 to 60 cc. of water. After standing a few minutes the solution is decanted through a filter. This operation is repeated twice. The residue is then brought upon the filter and washed until the washings amount to nearly $\frac{3}{4}$ liter. A few drops of hydrochloric acid are added and the flask filled to the mark (250 cc.?). Fifty cubic centimeters of this solution is mixed with 30 cc. of ammonium citrate (Petermann's formula[1]) and 10 cc. of ammonia, and 30 cc. of magnesia mixture is added drop by drop with continuous stirring.

For determining both water-soluble and citrate-soluble phosphoric acid in the same sample the following method is given: Of superphosphates containing over 18 per cent of phosphoric acid and of precipitated phosphates 1 gm. is taken for analysis, of ordinary superphosphates 2 gm., and of mixed fertilizers 4 gm. The material is treated as

[1] Five hundred grams of citric acid is dissolved in concentrated ammonia (0.92 sp. gr.) to a neutral reaction. The specific gravity is brought to 1.09 at 15° C. and 50 cc. of ammonia (0.92 sp. gr.) added.

described above, care being taken to prevent precipitation of gypsum on the filter when examining superphosphates. The residue on the filter is washed until the filtrate amounts to at least 200 cc. The filter with its contents is then brought into a 250 cc. flask containing 100 cc. of Petermann's alkaline ammonium citrate, thoroughly shaken, allowed to stand for 15 hours in the cold, and then digested for 1 hour in a water bath at 40° C. A few drops of hydrochloric acid are added to the water solution and the flask filled to the mark (250 cc.?). After cooling, the flask containing the citrate solution is also filled to the mark. The solution is passed through a filter and 50 cc. measured out into a beaker, with a pipette for the determination. An equal amount of the water solution is measured out in the same way. Both beakers are then placed in a mechanical stirrer and 35 cc. of magnesia mixture, drop by drop, and 10 cc. of ammonia are added. The stirring is continued for 25 minutes. When the precipitates have settled the solutions are filtered and the precipitate is washed with 2.5 per cent ammonia until free from chlorids, ignited first over a simple burner, then over a blast lamp, and weighed.

Determination of the relative assimilability of crude phosphates.—The Congress requested the experiment stations to study this subject.

Determination of iron and alumina in crude phosphates.—The Congress urged the use of a uniform method and adopted that of Crispo, which has given concordant results. This method is carried out as follows: Five grams of phosphate is dissolved in *aqua regia* (40 cc. of HCl of 1.1 sp. gr. and 10 cc. of HNO_3 of 1.2 sp. gr.) and the solution made up to 500 cc. To 50 cc. of this solution 2 cc. of ammonia (0.96 sp. gr.) is added (leaving the solution still acid) and finally 50 cc. of half saturated ammonium chlorid. The solution is then boiled and if it becomes cloudy it is cleared up with a few drops of nitric acid. Ten cubic centimeters of ammonium acetate solution (1.106 sp. gr.) is now added, the solution boiled 2 or 3 minutes, cooled, and filtered. The precipitate thus obtained is washed twice with dilute ammonium chlorid solution ($\frac{1}{10}$), dissolved in 2 cc. nitric acid, and the filter washed out with hot water. The phosphoric acid is precipitated with about 40 cc. of molybdic solution, the solution filtered, and the precipitate washed 3 or 4 times with 1 per cent nitric acid. Fifty cubic centimeters of half saturated ammonium chlorid solution and a slight excess of ammonia are added to the filtrate, the solution is heated a few minutes and filtered, and the precipitate washed 3 or 4 times with hot water. The precipitate is again dissolved in 2 cc. of nitric acid and the filter washed out with hot water. To the solution thus obtained 50 cc. of ammonium chlorid solution and a slight excess of ammonia are again added with heating. The precipitate is collected on a filter washed with hot water, ignited, and weighed.

The determination of nitrogen in nitrates and nitrogen derivatives in the wet way, M. KRÜGER (*Ber. deut. chem. Ges., 27 (1894)*,

No. 12, pp. 1633–1635).—In the method proposed 0.2 to 0.3 gm. of substance is placed in a flask with 20 cc. of water (or in case of difficultly soluble substances 20 cc. of alcohol), 10 cc. of a strong hydrochloric acid solution of tin chlorid containing 150 gm. of tin per liter, and 1.5 gm. of tin dust. The mixture is heated over a small flame until the tin is dissolved and the solution is perfectly colorless.

After cooling, 20 cc. of concentrated sulphuric acid is carefully added. If alcohol is used, this should be completely reduced before sulphuric acid is added.

The solution is digested until copious fumes of sulphuric acid appear, and after cooling the amid compounds are oxidized by the addition of a little more than the calculated amount of potassium bichromate. In the case of nitrates the use of bichromate is, of course, unnecessary.

The remaining operations are carried out as usual. The results of determinations of nitrogen in potassium nitrate and a number of nitrogen derivatives are reported, showing a close agreement with the calculated percentages.

Volumetric determination of nitric acid, D. MONNIER and H. AURIOL (*Arch. Sci. Phys. Nat. Genève, 31, p. 352; abs. in Bul. Soc. Chim. Paris, 11–12 (1894), No. 18 and 19, p. 988*).—The apparatus devised for the determination of free or combined nitric acid in water is described. The method suggested is based on the reduction of nitrates in an acid solution by nascent hydrogen evolved by sodium amalgam. About half a liter of the water to be analyzed is evaporated, and the amount of hydrogen evolved by a given weight of the amalgam as compared with the volume evolved by the same amount of amalgam in pure water is measured. The difference is taken to correspond to the hydrogen used in the reduction of the nitrates.

The volumetric determination of water-soluble phosphoric acid in superphosphates by Kalmann and Meissels' method, C. GLASER (*Chem. Ztg., 18 (1894), No. 80, pp. 1533, 1534*).—Attention is called to the fact that A. Emmerling[1] proposed several years ago a method based upon the same principle as that involved in the Kalmann and Meissels[2] method. A few possible sources of error are pointed out and a substitute for Kalmann and Meissels' method is proposed, in which the principal modifications are the carrying out of both titrations (with methyl orange and phenolphthalein) in the same aliquot part of the solution and the addition of an excess of perfectly neutral calcium chlorid solution before the titration with phenolphthalein is undertaken.

In calculating the results each cubic centimeter of tenth-normal soda solution used in the first titration is taken to correspond to 7.1 mg. of phosphoric acid, and in the second titration to 3.55 mg. of phosphoric acid.

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[1] Landw. Vers. Stat., 1886, p. 429.

[2] Chem. Ztg., 18 (1894), No. 54, Repert., p. 180.

Comparative tests of this method and of the gravimetric method on 20 samples gave the following average results: Volumetric method, 21.36 per cent; gravimetric method, 21.26 per cent. An attempt was made to apply this method to the determination of total phosphoric acid. While the average results agree closely with those obtained by the gravimetric method, individual results are somewhat irregular, and in other respects the method appeared to possess no advantages over the usual methods.

Determination of the citrate-soluble phosphoric acid in Thomas slag and untreated phosphates, P. WAGNER (*Chem. Ztg., 18 (1894), No. 61, pp. 1153, 1154; abs. in Analyst, 1894, Sept., pp. 205, 206*).—On account of the wide variations in the results of field experiments with different samples of slag, the author insists on the necessity of a guaranty of solubility of the phosphoric acid. Two methods of determining the solubility of the phosphoric acid in acid ammonium citrate solution are proposed. In the first, which is considered the more accurate, the basicity of the slag is determined and neutralized with citric acid previous to treatment with citrate solution.

The basicity is determined as follows:

"Five grams of the slag is introduced into a 500 cc. flask, which is then filled up to the mark with a 1 per cent solution of citric acid and shaken for half an hour in a jigger; 50 cc. of the filtered liquid is then titrated with a one fourth normal soda solution, phenolphthalein being the indicator.

"For the actual analysis, 5 gm. of the sample is placed in a 500 cc. flask with 200 cc. of water, and there are successively added (1) the quantity of 5 per cent citric acid solution previously found to be necessary to neutralize the slag, (2) 200 cc of acid ammonium citrate solution (see below), and (3) water to the mark. The mixture is shaken in a jigger for half an hour and filtered; to 50 cc. of the filtrate 100 cc. of molybdic solution (see below) is added; the liquid is heated to 80° C., and after cooling the precipitate is filtered and treated as usual.

"The ammonium citrate solution is made by dissolving 160 gm. of citric acid and ammonia, equivalent to 28 gm. of nitrogen, in a liter of water. The molybdic solution is prepared by dissolving 125 gm. of molybdic acid in a slight excess of 2.5 per cent ammonia solution, adding 400 gm. of ammonium nitrate, diluting to 1 liter, and pouring the solution into 1 liter of nitric acid (1.19 sp. gr.). After having been allowed to remain at 35° C. for 24 hours the solution is filtered."

If it is desirable to save time the determination of the basicity may be omitted and a citrate solution containing 150 gm. of citric acid and ammonia, equivalent to 23 gm. of nitrogen, may be used, but the results are less accurate than those furnished by the first method.

A new method of determining potash, H. SCHWEITZER and E. LUNGWITZ (*Chem. Ztg., 18 (1894), No. 69, pp. 1320–1322*).—In previous articles[1] one of the authors has called attention to the inaccuracy of the Lindo-Gladding method, and in the present article the results are given of efforts to devise a method which should be as accurate as the original Fresenius method but easier of manipulation. The essential features of this method are precipitation of the alkaline earths by

[1] Chem. Ztg., 16 (1892), p. 1720 (E. S. R., 4, p. 584), 17 (1893), p. 101.

barium oxalate in an acid solution and subsequently of iron and alumina by the addition of a slight excess of ammonia.

The following directions for applying the method to the examination of fertilizers are given: With superphosphates 10 gm. of the material is mixed with 500 cc. of water and an amount of a solution of oxalate of barium in hydrochloric acid (5 cc. of acid of 1.19 sp. gr. to each 7 gm. of oxalate) corresponding to 15 gm. of oxalate of barium. The solution is then boiled vigorously for 20 minutes, hydrogen peroxid added to oxidize the ferrous oxid, and finally a slight excess of ammonia added. It is cooled, made up to a definite volume (1 liter?), and filtered. An aliquot part is evaporated, the residue ignited, taken up in hot water, filtered if necessary, and 1 to 2 drops of hydrochloric acid and the necessary amount of platinum chlorid added. In some cases the ignited residue may be at once dissolved in hydrochloric acid and treated with platinum chlorid.

With kainit the proportions used are 10 gm. of the pulverized salt and an amount of the reagent corresponding to 10 gm. of oxalate of barium.

The method was tried on a large number of substances containing potash, and gave concordant and accurate results, and proved to be easy of manipulation. For very impure products it seemed to possess special advantages.

The reactions which take place in this method are thus explained: The hydrochloric acid decomposes the oxalate of barium, forming barium chlorid and free oxalic acid. The barium chlorid precipitates the sulphuric acid present and all the bases pass into solution as chlorids. The precipitation of sulphuric acid taking place in an acid solution is free from potash. Only enough of the barium chlorid to precipitate the sulphuric acid is decomposed. At the same time there is just enough oxalic acid present to combine with bases previously united with sulphuric acid and with the barium of the unused barium chlorid. When ammonia is added to a distinctly alkaline reaction, all chlorin combines with ammonia and the alkaline earths are precipitated as oxalates, the iron and alumina as hydroxids. The chlorids of alkalies remain in solution. In the presence of an excess of ammonia the solution may contain small amounts of the oxalates of barium and magnesia, but these are removed when the solution is subsequently evaporated to dryness, ignited, taken up in water, and filtered.

The estimation of potash in manures, V. EDWARDS and E. W. T. JONES (*Chem. News, 70 (1894), No. 1817, p. 140; No 1819, p. 172*).—The essential features of Edwards' method, which is claimed to be less "troublesome and tedious" than the ordinary text-book methods, are as follows: One gram of the substance is charred (if it contains much organic matter) and boiled with water containing a few drops of hydrochloric acid. The solution thus obtained, purified by precipitation with ammonia and ammonium oxalate, is evaporated to dryness with a

slight excess of sulphuric acid and ammonia salts expelled. The residue is dissolved in very dilute hydrochloric acid, an excess of platinum chlorid added, and the solution is evaporated to a moist paste on a water bath below boiling. The double salt is washed by decantation, once with water (20 cc.) containing a few drops of hydrochloric acid and 3 times with alcohol, dried, and weighed.

Jones criticises this method as being "unnecessarily long and essentially faulty in more than one particular," and proposes the following substitute for it:

"Take 1 to 2 gm. of the sample, put into a platinum dish, add half its weight of calcium hydroxid ($Ca(HO)_2$), mix well with a short stirring rod, then gently ignite. This destroys organic matter and dissipates ammonia. Put the mass, when cool, into a small glass mortar and triturate with a little water, rinse into a beaker, digest, filter, and, of course, wash the easily washed residue. The filtrate is colorless and only contains in solution what calcium sulphate and calcium hydroxid the amount of water will dissolve, besides the alkaline salts. Add to this solution 2 or 3 drops of hydrochloric acid till *just* acid, then, drop by drop, barium chlorid solution to very slight excess; digest on hot plate, then filter. Add to this filtrate, drop by drop, sodium carbonate solution till no further precipitation occurs; digest and filter; acidify the filtrate with hydrochloric acid, evaporate over water bath with platinum chlorid solution, and proceed as usual."

The determination of albumen in cows' milk, L. L. VAN SLYKE (*Jour. Amer. Chem. Soc., 16 (1894), No. 10, pp. 712–715*).—In the author's method for casein[1] about 10 gm. of milk is diluted with about 90 cc. of water at 40 to 42° C., and then 1.5 cc. of 10 per cent acetic acid (by weight) added. The casein precipitate is washed upon the filter, the nitrogen determined by the Kjeldahl method, and the casein calculated by the factor 6.25.

In the method now described for albumen the filtrate from the casein precipitate is heated in a boiling water bath for 10 or 15 minutes, when the albumen coagulates and settles out. Trials of heating from 5 minutes to 10 hours showed that the longer heating did not practically change the results. The filtered and washed precipitate is treated by the Kjeldahl method and the nitrogen multiplied by 6.25 to get the albumen.

The remaining nitrogenous compounds are determined by difference.

Trials of Brullé's method for the recognition of margarin in butter, C. A. LOBRY DE BRUYN (*Chem. Ztg., 18 (1894), No. 70, pp. 1341, 1342*).—This method[2] depends upon the degree of hardness of natural and artificial butter which has been oxidized with nitric acid. According to Brullé, butter treated in this way remains very soft, while margarin is usually very hard. The hardness is measured by the "oleogrameter," which shows the weight required to cause a rod to make an impression upon the surface of the oxidized material. Brullé gives this as 0.25 kg. for butter and about 5 kg. for margarin, but he does not give the size of

[1] Jour. Amer. Chem. Soc., 15 (1894), p. 635.
[2] Compt. Rend., 116 (1893), p. 1255; and E. S. R. 5, p. 450.

the rod used, which is very important. Trials with 20 samples of natural and artificial butter are reported, using rods of different sizes. Six grams of filtered fat (Brullé uses 6 cc.) was oxidized with 8 drops of fuming nitric acid, and the dish then heated for an hour at 21° C. This was done by placing the dish upon water kept at this temperature and submerging it as soon as the contents had hardened. The author found the temperature at which this heating was done to be a very important factor, since a variation of 1° or even less affected the results materially.

From the trials reported it appears that a rod 12 mm. in diameter gives results higher than Brullé's, and one 8 mm. lower results, while with one 10 mm. the results more nearly approached Brullé's. The results were not encouraging to the author, and he is inclined to doubt that 10 per cent of margarin can be detected with certainty, as claimed by Brullé.

Trials of König and Hart's method of butter analysis, C. T. MÖRNER (*Upsala läkaref. förhandl., 1894; abs. in Nord. Mejeri Tidn., 9 (1894), pp. 425, 426*).—The author investigated the applicability of König and Hart's method of butter analysis[1] for Swedish butters. The limits for pure butter fat found by König and Hart were 200 to 238, average 221 mg., while for oleomargarin the figures were 22, beef suet 36, leaf lard 17, mutton suet 5. The author examined 20 samples of genuine Swedish butter, manufactured during the months of March and April. The following baryta numbers were found: Minimum 180, maximum 228, average 200.7 mg.—F. W. WOLL.

A comparison of methods for the determination of starch, W. E. STONE (*Jour. Amer. Chem. Soc., 16 (1894), No. 11, pp. 726–733*).—It is urged at the outset that instead of determining the carbohydrates (except fiber) in feeding stuffs by difference and grouping them under the head of nitrogen-free extract, "a food analysis . . . should include determinations of the pentosans, sugars, and starches separately." In the comparison of methods pure starch, dried potato, wheat flour, corn meal, wheat bran, hay, wheat middlings, cotton-seed meal, and a mixture of starch, sugar, and dextrin were used. The methods tried were: (1) Inversion by hydrochloric acid and titration with Fehling's solution (Sachsse); (2) inversion with nitric acid and polarization (Guichard); (3) a modification of the preceding, first dissolving the starch with oxalic acid and then inverting; (4) inversion with salicylic acid and polarization (Baudry); and (5) precipitation with barium hydrate and determination of the excess of the latter by titration with standard acid (von Asboth).

On pure starch these methods gave satisfactorily concordant results, but on the other materials the results by different methods were "more or less discordant, and in some cases quite unexplainable."

"For instance, the hay and cotton-seed meal when boiled with water do not give iodin reaction for starch, yet each of these special methods for the determination of

[1] Ztschr. analyt. Chem., 30, p. 292.

starch credits them with from 4 to 60 per cent of the same. Even 15 minutes' warming with very dilute hydrochloric acid gives an appreciable amount of what we are bound to interpret as starch. This brings us to the inevitable conclusion that other bodies than starch are present and respond toward each of these reactions in the same way as starch does. We know, moreover, that the pentosans are such bodies, and that they are invariably present to a greater or less degree in materials of the kind under examination."

Portions of pentosan (xylan) isolated from wheat straw were treated according to the first, second, third, and fifth methods for starch mentioned above.

"These results show conclusively that the pentosan, which is most characteristic of feeding stuffs, and which has been shown to occur in all such materials, behaves toward the reagents named in precisely the same manner as starch, and in a no less marked degree. The conclusion is unavoidable that none of the methods for determining starch, based upon the above principles, can be employed with any degree of accuracy upon grains or forage plants or any materials where the presence of these pentosans is probable."

The most hopeful means of avoiding this difficulty the author believes to be removing the starch from the accompanying carbohydrates by some solvent that does not affect the latter, and suggests diastase for this purpose. This is a familiar method of starch determination which has been shown to yield accurate results with pure starch. Although the effect of diastase on the pentosans has not been thoroughly studied, some preliminary tests by the author indicate that these bodies are not affected by diastase.

Determination of starch by alcoholic fermentation, A. MUNSCHE (*Wochenschr. Brauerei, 9 (1894), p. 795; abs. in Chem. Ztg., 18 (1894), No. 70, Repert., p. 215*).—The author dissolved pure starch by means of a cold-prepared malt extract and then allowed the mash to ferment with yeast species, causing superficial fermentation. The starch was determined either from the carbon dioxid or the alcohol resulting. The experiments showed that starch could be completely inverted with diastase by barley malt and that with an absolutely pure fermentation by means of yeast ("class 2"), the fermentable inversion products could be fermented to the last trace in 60 hours. On an average 100 gm. of dry, pure yeast gave 51.29 gm. of carbon dioxid and 53.43 gm. of alcohol. The author considers it feasible to quantitatively determine the starch content by means of diastase and fermentation, as described above, and states that the method is free from the error arising in the ordinary method from other nitrogen-free extract, since the gums are not fermentable.

Investigations concerning the glycerol content of wine, P. KULISCH (*Forsch. ü. Lebensmtl., 1, pp. 280–288, 311–318, 361–373*).—The author considers the glycerol method of Neubauer and Borgmann inaccurate and unsatisfactory. The glycerol obtained by that method is far from pure, as it contains albuminoids and other substances insoluble in water, and sometimes an appreciable amount of sugar. According to him the limits for the glycerol alcohol ratio suggested by those

authors (7 to 14 parts of glycerol to 100 parts of alcohol) are too narrow. Many pure wines contain as little as 5.5 parts of glycerol to 100 parts of alcohol. He also says that some wines may be adulterated by the addition of 2 to 3 per cent of alcohol or 0.5 per cent of glycerol, without the possibility of its being detected.—W. D. BIGELOW.

Sugar and acid content of Victoria musts and their relation to the alcohol content of Victoria wines, W. P. WILKINSON (*Proc. Roy. Soc. Victoria, 1894, pp. 89–118; abs. in Chem. Centbl., 1894, II, pp. 259, 539*).—The author says the alcohol content of Victoria (and all Australian) wines is one half greater than in French or German wines. Of course the same proportion exists between the musts of the different countries in the percentage of sugar. The amount of acid is about equal in the musts of Victoria and France, but is greater in those of Germany.—W. D. BIGELOW.

Comparison of sodium carbonate, sulphate, and phosphate for removing the excess of neutral or basic lead acetate from clarified solutions poor in sugar, A. BORNTRÄGER (*Ztschr. angew. Chem., 1894, pp. 454–461*).—Only a slight excess of sodium carbonate or hydrogen disodium phosphate is necessary to remove the excess of lead from musts, wines, and other solutions poor in sugar, which have been clarified with either neutral or basic lead acetate, and the precipitation is complete in 1 hour. A large excess of the carbonate redissolves a slight amount of the lead, but this is not true of the phosphate. Sodium sulphate in slight excess precipitates neutral lead acetate completely in 1 hour, though a large excess leaves a trace of lead in solution for a much longer time. When basic lead acetate has been used, the precipitate obtained with sodium sulphate is only complete after 24 hours. Although the precipitate obtained with sodium sulphate is not as complete as those obtained by the other salts examined, and it requires a longer time for its formation, it is to be preferred, since it leaves a neutral filtrate.—W. D. BIGELOW.

Precipitation of lead from clarified wine and must, A. BORNTRÄGER (*Ztschr. angew. Chem., 1894, pp. 554–559*).—The author compares sodium sulphate and sodium carbonate as reagents for the removal of the excess of lead from clarified wine and must. He states that in using the latter serious errors may result from its effect on the rotatory power of invert sugar, while the former is not open to this objection. He also prefers sodium sulphate on account of the greater ease and rapidity with which its precipitate may be washed.—W. D. BIGELOW.

Application of physical methods to the examination of beer, J. REGENSBURGER (*Forsch. ü. Lebensmtl., 1, pp. 217–219; abs. in Chem. Centbl., 1894, II, p. 132*).—The author finds that the freezing point of beer which has been freed from carbonic oxid by shaking is lower than that of an aqueous solution containing the same amount of alcohol and extract. This is due to the presence of nitrogenous matter, which is precipitated on the distillation of the alcohol. Too high a figure is also

obtained by freezing the distillate, on account of the presence of volatile acids. The author regards an abnormally high electrical conductivity as an indication that a chemical examination should be made, as this may be due to the presence of sodium chlorid, sodium phosphate, or to magnesia added to neutralize the free acids.—W. D. BIGELOW.

The estimation of the acid content of malt, E. PRIOR (*Bayer. Brau. Jour., 4, p. 74; Vierteljahr. Chem. Nahr. und Genussmtl., 9, p. 102*).—A 2-hours' extraction with 20 per cent alcohol was found insufficient to dissolve all the acid. It should be continued 12 to 14 hours. At ordinary temperatures chloroform water retards the formation of acids.—W. D. BIGELOW.

Cane sugar in malt and wort, E. PRIOR (*Bayer. Brau. Jour., 4, p. 49; Vierteljahr. Chem. Nahr. und Genussmtl., 9, p. 103*).—The variations in the amount of cane sugar in malt and wort have considerable influence on the degree of fermentation, and the ordinary malt analysis, by which only reducing sugar is determined, is not sufficient.—W. D. BIGELOW.

On blue iodin-starch and the molecular structure of "dissolved" starch, F. W. KÜSTER (*Chem. Ztg., 18 (1894), No. 79, p. 1513*).—An abstract of a paper read at the Vienna meeting of the Association of German Natural Scientists and Physicians.

The action of alkalies on glucose, F. GAND (*Compt. Rend., 119 (1894), No. 15, pp. 604–606*).

Xylose and phloroglucin, C. COUNCLER (*Chem. Ztg., 18 (1894), No. 83, pp. 1617, 1618*).

Some of the chemical properties of myrosin, L. GUIGNARD (*Bul. Soc. Bot. France, 41 (1894), No. 6 and 7, pp. 418–428*).

Proteids of cotton seed, T. B. OSBORNE and C. G. VOORHEES (*Jour. Amer. Chem. Soc., 16 (1894), No. 11, pp. 778–785*).—The same as reported in Connecticut State Station Report for 1893, pp. 211–217 (E. S. R., 5, p. 1081).

Proteids of the kidney bean, T. B. OSBORNE (*Jour. Amer. Chem. Soc., 16 (1894), No. 9, pp. 633–643; No. 10, pp. 703–712; No. 11, pp. 757–764*).—The same as reported in Connecticut State Station Report for 1893, pp. 186-210 (E. S. R., 5, p. 1080).

A method for determining calcium oxid in quicklime, W. E. STONE and F. C. SCHEUCH (*Jour. Amer. Chem. Soc., 16 (1894), No. 11, pp. 721-725*).—The method is essentially as follows: "Approximately 1 gm. of the finely pulverized material is shaken with 150 cc. of a 10 per cent sucrose solution during 20 minutes, the solution filtered, and the clear filtrate titrated with standardized hydrochloric acid, using tropæolin or rosolic acid as an indicator."

Determination of nitrogen in nitrate of soda, etc., H. BUDOW (*Pharm. Ges. Ber., 1894, No. 4, p. 185; abs. in Chem. Ztg., 18 (1894), No. 84, Repert., p. 247*).—Attention is called to danger of error from incomplete distillation by following the directions in the alcohol method to distill until alcohol disappears.

Pemberton method for determining phosphoric acid, I. K. FRANKEL (*Amer. Fert., 1 (1894), No. 1, pp. 28, 29*).

Phosphoric acid determinations, C. GLASER (*Amer. Fert., 1 (1894), No. 3, pp. 143–145*).—Uniformity urged.

On the estimation of phosphoric acid by titration of the yellow precipitate, B. W. KILGORE (*Jour. Amer. Chem. Soc., 16 (1894), No. 11, pp. 765–772*).—This is a paper read before the Association of Official Agricultural Chemists at its 1894 meeting (E. S. R., 6, p. 180).

A modification of Tollens' fat extraction apparatus, U. MILONE (*Boll. Soc. Naturalisti in Napoli, 8 (1891), pp. 1–3; abs. in Chem. Centbl., 1894, II, No. 15, p. 642, fig. 1*).

Examination of flour, M. BALLAND (*Compt. Rend., 119 (1894), No. 14, pp. 565–567*).—The results of examinations of 2,500 samples of flour inspected in the State laboratory from September, 1891, to June, 1894, are discussed.

The use of tamarinds in the adulteration of wine, H. KALLBRUNNER (*Ztschr. Chem. Nahr., 8, pp. 172*).

Examination of medicinal sweet wines, J. PINNETTE (*Ztschr. angew. Chem., 1894, pp. 433–435*).

Complete analysis of wines, L. DELAYE (*Rev. Internat. Falsif., 7, pp. 178–182*). The article gives the French and German methods for the determination of alcohol, extract, ash, sulphuric acid, and total acidity.—W. D. BIGELOW.

Adulteration of wine (*Rev. Internat. Falsif., 7, p. 149*).—The author detects the presence of fermented cider in wine by testing for malic acid. He does not take into consideration the presence of malic acid in wine made from unripe grapes.—W. D. BIGELOW

Estimation of ash in wine, BARTH (*Forsch. ü. Lebensmtl., 1, p. 166; abs. in Chem. Ztg., 18 (1894), No. 58, Repert., p. 184*).—The author states that when the extract of a wine is ashed at a high temperature the organic matter present reduces some of the potassium salts to metallic potassium, which is volatilized.—W. D. BIGELOW.

Note concerning the nitrogenous constituents of beer and wort, C. AMTHOR (*Forsch. ü. Lebensmtl., 2, pp. 203–205; abs. in Chem. Centbl., 1894, II, p. 131*).

Examination of beer which is turbid with yeast cells, H. WILL (*Forsch. ü. Lebensmtl., 1, p. 389*).

The acid constituents of wines, P. L. ASLANOGLOU (*Chem. News, 70 (1894), p. 176*).—The methods given for determining the acids of wine will be found of considerable value, but on account of the time required for their execution and the amount of wine required are not adapted to the detection of adulteration.—W. D. BIGELOW

Aluminum chips for the clarification of beer, L. AUBRY (*Ztschr. ges. Brauw., 17, pp 155–158; abst. in Chem. Centbl., 1894, II, p. 131*).—Clarification a little slow, but beer so clarified is in no respect different from that clarified by wood shavings. Only the slightest trace of aluminum is left in solution.—W. D. BIGELOW.

The effect of the saline constituents of water on the character of beer, J. B. READMAN (*Jour. Soc. Chem. Ind., 13, pp. 367–375*).—Beers were made containing a known quantity of a number of salts, and the effect of each salt on the formation, character, and composition of worts noted.—W. D. BIGELOW.

Particles of nitrogenous materials in wort, beer, and yeast, H. WILL (*Ztschr. ges. Brauw., 17, pp. 187–189, 197–199, 205–207, 215, 231; abst. in Chem. Centbl., 1894, II, p. 392*).

Changes in official methods of soil and ash analysis, A. M. PETER (*Jour. Amer. Chem. Soc., 16 (1894), No. 11, p. 792*).—Changes adopted at the 1894 meeting of the Association of Official Agricultural Chemists (E. S. R., 6, p. 182).

Contributions to volumetric analysis, B. REINITZER (*Ztschr. angew. Chem., 1894, No. 18, pp. 547–554, fig. 1; No. 19, pp. 573–579, fig. 1*).

Improvements in the making of microscopes and in methods of microscopic examination, T. F. HANAUSEK (*Chem. Ztg., 18 (1894), No. 82, pp. 1597, 1598*).

Sulphuric acid tables (*Amer. Fert., 1 (1894), No. 3, pp 166, 167*).

A safety attachment for riders, C. E. PARKER (*Jour. Amer. Chem. Soc., 16 (1894), No. 11, pp. 764, 765, figs. 3*).

Report of chemical station at Halmstad (Sweden) for 1893, E. LYTTKINS (*Halmstad. 1894, pp. 8*).

BOTANY.

Report of the botanical department, J. C. ARTHUR (*Indiana Sta. Rpt. 1893, pp. 18–21*).

Synopsis.—Report on the deviation of development due to the use of unripe seed, on the reciprocal relation between the vegetative and reproductive parts of a plant under varying conditions of growth, and report of successful treatment of potatoes with corrosive sublimate for scab.

Experiments and observations have been conducted since 1889 on the use of immature tomato seed for the purpose of increasing earliness and productiveness.

During the winter of 1892–'93 plants were grown in the greenhouse from seed taken from half-grown fruit. Comparisons were made with plants grown under the same conditions from mature seed taken from the same parent. Comparing the results obtained in these experiments with observations made in previous years, the author concludes as follows:

"The principal deviations arising from the use of immature seed are: (1) A loss of vigor, shown in the smaller percentage of germinations, weakness of the seedlings, and greater number of plants which die before maturity; (2) failure to recover lost vigor, although the plants may, and usually do, produce an abundant harvest, and one acceptable to the cultivator; (3) the increase of reproductive parts in proportion to the vegetative parts, resulting in a greater number of fruits and seeds (although individually smaller) and more rapid ripening than in similar plants from mature seeds."

It is seen from the above that greater productiveness and earlier ripening of the fruit from immature seed is secured at the expense of the weakened plant. Whether sufficient vigor of plant can be secured by this method to make it profitable in commercial gardening is yet to be determined.

Bearing somewhat on the same subject the author investigated the reciprocal relation between the vegetative (leaf, stem, and root) and the reproductive (seed and fruit) parts of plants under varying conditions of growth. The generalization is reached that:

"'A decrease in nutrition of an organism favors the development of the reproductive parts at the expense of the vegetative parts.' The decrease in nutrition may be brought about by poor soil, bad tillage, slow germination, etc., all leading to the same general result. But it was pointed out that while partly starved plants are as a rule proportionately more productive, *i. e.*, per unit of vegetative part, the reverse is true of plants grown from large and small seeds, for 'large seeds produce stronger plants with a greater capacity for reproduction than small seeds of the same kind.' These conclusions, which are supported by experimental data, strongly emphasize the necessity of using only the largest seeds (that is, screening out and discarding the small seeds) for sowing, in order to secure not only the largest yield of grain and fruit, but also to retain the vigor and permanency of the race under high tillage."

The author treated seed potatoes with a solution of corrosive sublimate, 2 oz. in 15 gal. of water, and the resulting crop gave 90 to 95 per cent free from scab, as compared with 55 to 70 per cent from untreated seed.

On correlation of the growth of roots and shoots, L. KNY (*Ann. Bot., 8 (1894), No. 31, pp. 265–280*).—The author in a paper read before Section D of the British Association at its meeting at Oxford, August 11, 1894, considered the question raised by Voechting[1] whether there does not exist a relation of symmetry between root and bud, such that when the development of one is prevented the other will not take place. Facts of horticultural experience, especially the culture of dwarf trees in pots, tend to support this view, but on the other hand there are many facts which tend to prove that the different members of the plant body do not always develop at the same rate. Numerous instances are given in which the morphological equilibrium between root and shoot is disturbed, but these are exceptions. The normal cases are those of chlorophyll terrestrial plants in which the subaërial and subterranean parts are developed in due proportion, and it is in reference to these that the following questions suggest themselves: (1) Does there exist between the roots and shoots of a seedling such a correlation that the removal of one part inhibits the development of the other, or does the growth of one part stand in no relation whatever to that of the other in the developing seedling? (2) What is the limit to which the development of the shoots and roots of seedlings will proceed after the continual removal of the other part? (3) Are the phenomena of this kind which can be observed on isolated parts of adult plants different from those which are manifested by seedlings?

The author conducted experiments with seedlings of *Zea mays* and *Vicia faba* and cuttings of *Salix acuminata* and *S. purpurea*. The *Zea mays* seedlings were grown best on damp plates of burnt clay. In the case of *Vicia faba* one cotyledon rested on moist sand, so that the taproot grew over the edge of the dish into the damp air. The *Salix* cuttings were grown in water and so suspended that about half the cutting was submerged. In all cases, as far as possible, the seedlings were compelled to grow in moist air and were not given moisture sufficient to be absorbed directly in liquid form.

The plants were grown in 3 series, those of the first series being normal seedlings in which plumule and radicle could develop unhindered. In those of the second series were placed seedlings in which the plumule had been removed and in the third series the radicle was removed. Plants were inspected from time to time and measurements and weights taken. At the conclusion of all the experiments it was ascertained that starch was still abundantly present in the endosperm or the cotyledons, as the case may be, so that the seedling was still provided with plastic material for further growth. The following table

[1] Ueber Organbildung im Pflanzenreiche, 1, p. 51, 1878.

gives the average measurements and weights for the different series of cultures of seedlings and cuttings:

Average of cultures of seedlings and cuttings.

Series.		Length longest root.	Length longest shoot.	Gross weight roots.	Gross weight shoots.	Dry weight roots.	Dry weight shoots.
		Mm.	*Mm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*
1	*Zea mays* on clay plates	100.50	45.60	2.923	2.654	0.321	0.262
2	.....do	108.30	....	2.985	....	0.346	....
3	.....do	....	38.20	....	2.223	....	0.280
1	*Zea mays* on damp sand	154.00	95.00	4.400	3.750	....	....
2	.....do	123.00	....	5.350	....	....	....
3	.....do	....	34.50	....	1.350	....	....
1	*Vicia faba* on damp sand	79.30	41.16	5.162	3.218	0.524	0.339
2	.....do	66.30	....	4.999	....	0.496	....
3	.....do	....	46.50	....	3.898	....	0.412
[1]1	.....do	195.00	119.50	20.530	10.300	....	....
[1]2	.....do	188.75	....	23.060	....	....	....
[1]3	.....do	....	40.25	....	3.380	....	....
1	*Salix* cuttings in water	279.00	376.00	23.950	121.100	2.197	21.500
2	.....do	220.50	....	4.550	....	0.337	....
3	.....do	....	216.00	....	65.350	....	14.700

[1] In this series the seedlings were allowed to develop longer than in the other.

In general the conclusion to be drawn from the experiments is that in the seedlings of the species employed the growth of the roots and shoots is largely independent of each other. In *Zea mays* the dry weight of the roots at the end of the experiment was on the average very much the same, whether the shoots had been repeatedly removed or whether they had been allowed to remain, and the same is true of the shoots with reference to the presence or absence of the roots. In *Vicia faba* the primary shoots of those plants whose roots were removed could be readily observed at first to have developed more vigorously than primary shoots of those plants whose roots were not removed; whereas at the close of the experiment the contrary was the case, as is clearly shown by the difference between the gross weights (see second group under *Vicia faba* in table). The roots of those seedlings from which the shoots were removed showed little or no diminution, and their average weight is rather greater than in the case of the intact plants.

The remarkable independence of the development of the roots was apparent in other experiments made with the object of ascertaining to what length the roots would grow in water when the primary shoot and all subsequently developing shoots were removed. In *Zea mays* the roots attained the maximum length of 630 mm., in *Phaseolus multiflorus* a length of 661 mm., and in *Vicia faba* a length of 718 mm. An experiment was made with the seedlings of *Vicia faba* to ascertain the effect of the removal of the roots, and although this experiment involved considerable disturbance of the seedlings in consequence of repeated digging up and replanting, the growth of the shoots was not checked until they had attained a maximum length of 465 mm.

In the cuttings of *Salix* the effect upon the shoots of removing the roots and vice versa made itself apparent relatively early. The first thing to be noticed was a diminution in the development of the roots of those cuttings whose shoots had been removed, and somewhat later the development of the shoots whose roots had been removed. By analogy with the seedlings the opposite result would have been anticipated, as in the seedlings the roots asserted their independence of the shoots the longer.

It remains to determine by a more extended investigation to what extent the principles of correlation, as manifested in the growth of these few species, are of general application.

Are non-leguminous plants able to assimilate free nitrogen? F. NOBBE and L. HILTNER (*Landw. Vers. Stat.*, 45 (1894), No. 1 and 2, pp. 155–159).—The ability to assimilate the free nitrogen of the air as possessed by tubercle-forming plants, such as legumes, alders, *Eleagnus*, *Podocarpus*, etc., is recognized, and the claim recently set forth that non-leguminous or non-tubercle-forming plants have the same power was investigated by the authors. In those plants able to assimilate free nitrogen an increased nitrogen content is shown in their leaves and other parts above ground. It is claimed that some non-leguminous plants, as mustard, are able, indirectly, to contribute to the enrichment of the soil by stimulating to greater activity the known soil organisms.

In 1893 a series of experiments was conducted with mustard plants growing in sand, to which varying amounts of nitrogen were added from time to time. The total yield of nitrogen kept pace with the varying amount of soil nitrogen, and there was no increase due to assimilation of free nitrogen.

On June 15, 1893, a series of experiments with peas, mustard, buckwheat, and oats was begun. Nine pots of 5 liters capacity were filled from a mixture of 4,329 gm. sand and 1,000 gm. garden soil. The soil contained an average of 0.332 per cent of nitrogen, or 3.320 gm. per pot, 0.447 gm. being soluble. In addition each pot received 0.5 gm. potassium chlorid and 5 gm. calcium phosphate. The mixture of soil and sand was sterilized and then inoculated with an extract from a mixture of soil in which all 4 plants had previously grown. Two pots each were planted with 10 seeds of peas, mustard, buckwheat, and oats, and 1 pot left as a check. The aërial parts of the plants were harvested July 15, when the mustard and buckwheat were just coming into bloom, and tabular information is given as to the height of the plants, their dry matter, and nitrogen content. On July 27 and September 8 a second and third seeding were made as before, and the plants were harvested September 6 and November 7. Tabular informa-

tion is given as for the previous lot. The plants of the 3 seedings upon analysis yielded as follows:

Analysis of aërial parts of plants.

	Peas.		Mustard.		Buckwheat.		Oats.	
	Dry matter.	Nitrogen.	Dry matter.	Nitrogen.	Dry matter.	Nitrogen.	Dry matter.	Nitrogen.
	Grams.	*Gram.*	*Grams.*	*Gram.*	*Grams.*	*Gram.*	*Grams.*	*Gram.*
First seeding, 10 seeds	3.620	0.157	2.383	0.105	2.957	0.121	1.951	0.082
Second seeding, 25 seeds	5.655	0.271	3.961	0.109	3.096	0.087	4.120	0.132
Third seeding, 25 seeds	5.289	0.256	0.950	0.023	1.216	0.026	2.204	0.047
Total	14.564	0.684	7.294	0.237	7.269	0.234	8.275	0.261

The nitrogen balance in grams for the whole series is as follows:

Nitrogen balance.

	Peas.		Mustard.		Buckwheat.		Oats.		Check pot.
	Grams.		*Grams.*		*Grams.*		*Grams.*		*Grams.*
Nitrogen in original soil	3.320	3.721	3.320	3.338	3.320	3.347	3.320	3.368	3.320
Nitrogen in seed	0.401		0.018		0.027		0.048		
Nitrogen in harvest	0.684	4.258	0.237	3.574	0.234	3.602	0.261	4.105	3.374
Nitrogen in roots	0.175		0.068		0.042		0.226		
Nitrogen in soil after harvest	3.399		3.269		3.326		3.618		
Total gain in nitrogen		0.537		0.236		0.255		0.737	0.054

From the last table it is shown that there were gains made in every case over the original. In the case of the check pot the gain is so slight as to fall within the limits of error.

The first table shows that the peas alone were able to acquire the nitrogen of the air, and the other 3 genera showed a decline in spite of the increased amount of nitrogen in the soil. It goes to show that (1) peas and other tubercle-forming plants occupy a position separate from the non-tubercle-forming plants so far as nitrogen assimilation is concerned, and (2) the 3 non-leguminous plants were unable to take up the nitrogen, which went to enrich the soil.

From the plants of the second and third sowings it can not be claimed the increased nitrogen was acquired through the plants, as they would hardly be stunted in growth due to a deficiency of nitrogen while storing it up in the soil. There seems no other explanation than that the enrichment of the soil takes place in the soil itself, as has been shown by Winogradsky, Berthelot, and others, as due to the action of soil bacteria. The nitrogen so stored up is not immediately available to the plants, but is rendered so by nitrification.

The authors' experiments in 1894 tend to support this supposition.

The formation of root tubercles among legumes, C. NAUDIN (*Jour. Agr. Prat., 58 (1894), No. 39, pp. 453, 454*).—The author mentions the unsuccessful attempts to grow *Lespedeza virgata*, a species of *Cassia* from Senegal, *Balsamocarpon brevifolium*, and other species of tropical

and subtropical legumes. On none were there any tubercles developed. On the other hand, there were grown without any trouble *Arachis hypogea*, *Soja hispida*, several species of *Cassia*, some of which are closely related to those mentioned above as failing, *Poinciana* and *Bauhinia* species, and *Acacia* and *Mimosa* species from Australia. On all of these there was a conspicuous development of tubercles. The question is raised, without any attempt at answering it, as to whether there are few or many kinds of bacteria capable of tubercle production, and why the apparently indigenous species are able to inoculate the roots of some and not other foreign *Leguminosæ*.

The formation of proteids in plant cells, O. LOËW (*College Agr., Tokyo, Japan, Bul., vol. 2, No. 2, pp. 43–67*).—The importance of the formation of albuminous matter in plant cells is shown, and the following review given of the author's views. This synthesis is common to all kinds of plants, the chlorophyll-bearing plants deriving their carbon mainly from the carbohydrates, while the fungi make use of a variety of organic compounds. Ammonium salts, ureas, ammonium bases, etc., can serve as sources of nitrogen, while the sulphur comes from sulphates and various organic sulphur compounds. It seems highly probable that the proteids derived from any of these sources will be the same; otherwise the protoplasm formed would show variations according to the difference in food. Regarding the various sources from which the plant must form its proteids, some are of greater availability than others. Among the lower fungi the nutritive value of acids and alcohol is increased by the entrance of a number of hydroxyl groups, and the presence of aldehyde or ketone groups increases their assimilability. The lower alcohols and members of the fatty groups are more available than the higher ones, etc. In culture solutions organic bases are best neutralized with phosphoric acid, while acids are best supplied from sodium salts. A list of compounds is given which will support bacterial growth either very feebly or not at all, while if a 0.2 per cent solution of peptone be added there is a rapid development, showing that these substances are not poisonous to such a degree as to kill the bacteria if sufficiently nourished.

Among the alcohols, the higher members, up to amyl alcohol, have noxious qualities, and must be used in very great dilution to grow bacterial vegetation. The nutritive value of the fatty acids decreases in proportion to the increase in their molecular weight. Nutrient solutions containing 0.5 per cent of sodium acetate readily grew colonies of *Penicillium*, *Saccharomyces*, *Mycoderma*, and bacteria from putrid meat, while when the same amount of sodium valerianate was used only a slight development of bacteria was observed. Methyl alcohol, as well as methylal and methyl sulphuric acid in proper dilutions, may be used by bacteria in building up protein and protoplasm. It is claimed that the group used for the formation of proteids must contain but one atom of carbon, and can not be anything else than formic aldehyde, which by

condensation is capable of forming various sugars, or it must by oxidation be capable of being reduced to formic aldehyde.

The following table shows the value of a number of compounds as sources of carbon for fungi:

Compounds available as sources of carbon.

Good.	Fairly good.	Poor.	Probably not available.
Glycerin	Methyl alcohol	Phenol	Pinacone.
Mannit	Aethylenglycol	Acetoxim	Sulfonal.
Sugars	Acetone	Diacetonamin	Amidoacetal.
Lactic acid	Acetic acid	Valerianic acid	Oxalic acid.
Succinic acid	Fumaric acid	Maleïc acid	Meconic acid.
Tartaric acid	Pyruvic acid	Citraconic acid	Picric acid.
Citric acid	Lævulinic acid	Benzoic acid	Antipyrin
Betaïn	Glycocoll	Lecithin	Dimethyl-oxypyrimidin.
Alanin	Methylamin	Trimethylamin	Aethylendiamin
Leucin	Cholin	Strychnin	Pyridin.
Asparagin	Allantoin	Hexamethylenamin	Urea.
Glutamin	Coffeïn	Amidobenzoic acid	Parabanic acid
Creatin	Methyl cyanid	Glyoxylic acid	Guanidin.

The great variety which exists in the sources of carbon is also true regarding the sources of nitrogen. Nitrites, in some concentrations, are less favorable than nitrates, and in acid solutions they are poisonous. Regarding the sources of nitrogen, the author says:

"The nitrogen compounds used must be converted first into one and the same atomic group before the synthetical work can begin. This group is evidently ammonia, which, in form of salts, is not only very favorable for mold fungi and bacteria, but also the simplest nitrogen compound that can directly be utilized. Nitrates have to be reduced first. If organic nitrogen compounds are used as sources of nitrogen, the latter has to be split off in shape of ammonia before the protein formation can begin. This can be accomplished in many cases by simple splitting; in other cases by oxidation. . . .

"The anaërobic microbes may, by reducing influences, transform nitrogen of certain compounds into ammonia, while the aërobic employ oxidation. . . .

"A very remarkable case is the assimilation of free nitrogen by certain bacteria of the soil, as was asserted years ago by Berthelot and recently confirmed by Winogradsky. The free nitrogen is here probably first converted into ammonium nitrite, and the nitrous acid then also rapidly reduced to ammonia."

As sources of sulphur the organic sulphur compounds must be split up, forming hydrogen sulphid, to become available. The hydrogen sulphid is produced only in such quantity as is immediately required, an accumulation being noxious.

The conclusion is reached that the atomic groups serving for the formation of proteins in fungi are formic aldehyde, ammonia, and hydrogen sulphid. Among chlorophyll-bearing plants carbohydrates are produced by assimilation, and these furnish the principal source of carbon for proteids. Nitrates or ammonia salts supply the nitrogen and the sulphates the sulphur. The reduction of the nitrates and sulphates must take place, as in the case of the lower fungi. When all conditions are favorable the synthetical processes take place so rapidly that the intermediate steps can not be directly traced. Numerous

experiments show that asparagin plays a very important rôle in this connection. Asparagin occurs normally in many plants and under special cases in many more. It has been demonstrated that the production of asparagin is connected with a decrease in protein matter, and numerous cases are cited showing that the greater portion of the nitrogen of the protein reappears in the form of amido-compounds, as asparagin and glutamin. There appears a close connection between the decrease of the carbohydrates and an incipient decomposition of proteid compounds with the production of asparagin, and the amount of asparagin formed in the process of germination increases as the reserve carbohydrates decrease. The proportion of protein to carbohydrates is given for quite a list of seeds and parts of plants. In addition to asparagin there are found in some plants various other nitrogenous compounds, the principal ones being leucin, tyrosin, arginan, allantoin, guanidin, and glutamin.

The quantity of amido-acids during the first period of germination is constantly decreasing, while that of asparagin is increasing. The primary amido-products are said to disappear first, their carbon going partly to support respiration, and the rest, together with the nitrogen, forming asparagin, which in turn disappears with the increase of glucose formed by the chlorophyll. This is believed to indicate that asparagin is a transitory product, found when the conditions for protein synthesis are not complete. The accumulation of asparagin is connected with the gradual disappearance of amido products resulting from a decomposition of protein.

The asparagin in plants has two scources; it is either directly formed from glucose, ammonia, or nitrates, and sulphates; or it may be a transitory product between protein decomposition and reconstruction. Although originating from widely different materials, the processes closely resemble each other, if indeed they are not identical. To effect the synthesis of proteids a certain amount of energy is required, which is supplied by respiration; this in turn causes the partial oxidation necessary for transforming glucose into asparagin or aspartic acid. Wherever respiration is impeded protein production is checked, and, as it is best supported by the carbohydrates, glucose plays a still more important rôle in protein formation, yielding chemical energy. As the leaves produce by assimilation large amounts of glucose, they are also the most favorable organs for protein production.

Glucose is highly important in protein formation in many ways. It not only is a source of carbon, but enables reductions and yields the energy necessary for respiration. It also protects protein against decomposition. If the respiration process finds neither sugars nor fat, then the reserve protein is attacked, and yields a portion of its carbon for the wants of respiration. Another portion, splitting up into formic aldehyde and ammonia, forms asparagin to be again stored up for later use. The reserve protein is present in full-grown plants only in solution

in the vacuole, and may be either active or passive albumen. Passive albumen is produced by the transformation of the active unstable albumen, and is not a product of synthesis. This, the author claims, is clearly shown by the chemical processes known to take place.

On the existence of oxalate of lime in solution in plants, E. BELZUNG (*Jour. Bot. France, 8 (1894), No. 12, pp. 213-219*).—The author conducted a series of investigations on the form in which oxalate of lime exists in plants and found (1) that in addition to the crystallized and granulated forms there exist solutions of the same in unstable combination with certain free acids in the cell sap. The most usual forms are "citroxalate" and "oxoxalate" of lime; (2) oxalate of lime plays the part of a reserve nutritive material for the plant, as may be seen during the process of germination of various seeds. Oxalate of lime may exist in solution in very considerable quantity in a plant, but not enough to manifest itself as crystals in one plant, nor should it be affirmed from this that it is wholly absent in another. This is shown in the cotyledons of 2 species of lupines. In *Lupinus luteus* it occurs as crystals, while in *L. albus* it is wholly in solution.

On the occurrence of mucin in plants, J. ISHII (*College Agr., Tokyo, Japan, Bul., vol. 2, No. 2, pp. 97-100*).—Hitherto the slimy material known to be present in many plants has consisted of carbohydrates, which upon treatment yield various sugars, as galactose, arabinose, mannose, etc., while the animal slimes are protein compounds. The author found in the tuberous roots of Japanese yams, *Dioscorea* spp., a slimy matter easily precipitated by acetic acid, and further investigation showed it to belong to the mucins. Detailed information is given as to the preparation of the slime from the yams and its reaction with various chemicals. An analysis made of the purified substance dried at 110° C. gave as an average of 3 analyses, carbon 52.82 per cent, hydrogen 7.53, nitrogen 14.20, oxygen and sulphur (calculated) 25.05, and ash 0.41. From this composition it is seen to be approximately the same as the mucin of bile, although its identity is not claimed.

The author concludes as follows:

"Our slime shows all the essential characteristics of the animal mucin, and differs only in some subordinate points; it is with more difficulty soluble in dilute alkalis and yields a turbidity with potassium ferrocyanid. Our substance is doubtless a kind of mucin, and as this is the first time that such a compound has been found in the vegetable kingdom, it is certainly of physiological interest. The quantity, determined as accurately as possible, amounts to 8 per cent of the tuber dried at 100° C."

Mannane as a reserve material in the seeds of Diospyros kaki, J. ISHII (*College Agr., Tokyo, Japan, Bul., vol. 2, No. 2, pp. 101, 102*).—The investigations of the author showed that the flesh of the fruit contains large amounts of dextrose and levulose, but no mannose nor galactose. Upon examining the seed no starch was to be found, but a soft white mass as a reserve material, which could easily be converted

into sugar by boiling with 5 per cent sulphuric acid for an hour. By treating this product with barium carbonate to remove the sulphuric acid and then filtering and treating the filtrate with acetate of phenylhydrazin, after a few manipulations there were formed yellow needles, soluble with difficulty in hot alcohol and melting at 205° C., evidently phenylglucosazon. From this it is concluded that the sugar is mannose, and the white substance of the seed is called mannane, a polyanhydrid of mannose. It is shown that the seed stores up in the form of an anhydrid, a sugar that is different from the sugars contained in the flesh of the fruit.

On the reserve protein in plants, G. DAIKUHARA (*College Agr., Tokyo, Japan, Bul., vol. 2, No. 2, pp. 79–96*).—The author has sought to discover the form in which reserve protein is held by plants in addition to the aleurone in their seeds. It is supposed that albumen is present in solution in all the plant juices ready for use when needed by the plant. The relation of active albumen to the production of amido compounds in branches placed in water, and when plants are deprived of light, or in leaf buds in spring, has not yet been determined. Experiments were conducted to ascertain the function of the active albumen in the bark, leaves, flowers, and roots of various plants. The methods of treatment were those suggested by Loëw in Bulletin, vol. 2, No. 1 (E. S. R., 5, p. 111), modified in certain particulars to meet the necessities of the experiment. The details of the experiments and behavior of the proteosomes when subjected to various chemical manipulations are given. It is shown that the decrease of active albumen stands in close relation to the formation of asparagin.

In order to determine the frequency with which active albumen occurs in plants, microscopical examinations were made of various parts of 104 species of plants, representing 52 orders. Of these, 51 species in 29 orders contained active albumen stored up as a reserve material. Of the others many contained passive albumen, while some do not store up any albuminous matter in their fully developed tissues. Active albumen sometimes accumulates in the flowers, and is entirely absent in the adjacent parts of the plant. In the *Gramineæ* it was found only in the epidermis, and there only in a certain period of development. In the shade active albumen is formed less abundantly than in sunlight. Young leaves are richer in it than old ones, and partly etiolated leaves may show it as abundantly in their white parts as in the green portions.

The influence of light on diastase, J. R. GREEN (*Ann. Bot., 8 (1894), No. 31, pp. 370–373*).—It having been shown that the amount of diastase which can be abstracted from foliage leaves varies greatly in 24 hours, being greatest after a period of darkness, and relatively less after a long period of illumination, and that solar rays exercise a very destructive influence on certain enzymes that are secreted by various bacteria, the author investigated the possibility of light being destructive

to the ordinary enzymes of vegetative organisms. Diastase, being easy of extraction, was the one selected, and for the experiments it was prepared from ordinary malt. The mode of experiment was to prepare some extract of malt by infusing the ground grains with water or salt solution and expose half the quantity to strong light, either solar or electric, for varying times; then measured quantities of the exposed and unexposed halves were allowed to act upon a thin starch preparation at about the ordinary laboratory temperature. When digestion was well advanced, both tubes having been boiled with excess of Fehling's solution, the resulting precipitate was collected, washed, ignited, and weighed as copper oxid.

The results of the experiments were as follows: (1) Light, whether solar or electric, exercises a destructive effect upon diastase; (2) the deleterious influence is confined to the rays of the violet end of the spectrum, the others being slightly favorable rather than destructive; and (3) the coloring matter of the barley husk acts as a screen, preserving the diastase from the destructive effect of light.

The destructive influence continues after the exposure to light is discontinued, the exposed solution getting weaker and weaker until it has no diastatic action. The part of the solution kept in darkness maintained its diastatic power unimpaired for more than a month, by which time the exposed part possessed no power to act upon the starch.

Insectivorous plants, P. GEDDES (*Chapters in Modern Botany, 1894, pp. 1–59, figs. 4; abs. in Sci. Gos., n. ser., 1 (1894), No. 7, pp. 159*).—Illustrated descriptions are given of the known insectivorous plants, with summaries of the latest experiments upon their physiological action. The author still insists on the importance of insect catching as a source of nitrogen to the plant, in spite of the contention of recent authors that the secretive glands of pitcher plants are not special and essential adaptations toward insect capture and digestion, but mere water stomata which play the part of regulators of transpiration.—L. O. HOWARD.

Revision of the genus Lathyrus in North and Central America, T. G. WHITE, (*Torrey Bul., 21 (1894), No. 10, pp. 444–458*).—A preliminary revision of the genus and description of new species.

The Smilaceæ of North and Central America, T. MORONG (*Torrey Bul., 21 (1894), No. 10, pp. 419–443*).—A revision of the genus and description of new species.

Popular American plant names, F. D. BERGEN (*Bot. Gaz., 19 (1894), No. 11, pp. 429–444*).

On the mechanism of plant respiration, L. MAQUENNE (*Compt. Rend., 119 (1894), No. 17, pp. 697–699*).

Nature and distribution of attraction spheres and centrosomes in vegetable cells, J. H. SCHAFFNER (*Bot. Gaz., 19 (1894), No. 11, pp. 445–459, pl. 1*).

The periodic reduction of the number of chromosomes in the life history of living organisms, E. STRASBURGER (*Ann. Bot., 8 (1894), No. 31, pp. 281–316*).

Geotropic sensitiveness of the root tip, W. PFEFFER (*Ann. Bot., 8 (1894), No. 31, pp. 317–320*).—A preliminary paper in which it is shown that only the tip of the root is geotropically sensitive, and it induces the curvature of the root.

Contributions to life histories of plants, T. MEEHAN (*Proc. Phil. Acad. Sci., 1894, pt. 2, pp. 163–171*).—Articles are contributed on the morphology of bractless inflorescence, purple-leaved plants, the origin of the apical cell, the fall of the leaf in holly, and bees and honeysuckles.

Do plants use the nitrogen of the air? C. M. AIKMAN (*Agr. Jour. Cape Colony, 7 (1894), No. 20, pp. 462, 463*).—A popular résumé.

The inorganic material of plants, Z. ESPEJO (*Bol. Nac. Agr., 18 (1894), No. 15 and 16, pp. 378–380*).

On the presence of methyl salicylic ether in plants, E. BOURQUELOT (*Compt. Rend., 119 (1894), No. 19, pp. 802–804*).—Found in *Gaultheria procumbens, G. punctata, G. leschenaultii, Betula lenta, Polygala alba, P. senega, P. vulgaris*, and *Monotropa hypopitys*.

FERMENTATION—BACTERIOLOGY.

The rôle of bacteria in agriculture, H. WILFARTH (*Ztschr. landw. Cent. Ver. Sachsen, 1894, No. 8, pp. 281–287*).

Preparing culture media, J. L. SMITH (*Internat. Jour. Micr. and Nat. Sci., 4 (1894), ser. 3, pp. 369–371*).

Plate cultures of anaërobic bacteria, F. G. NOVY (*Centbl. Bakt. und Par., 16 (1894), No. 14, pp. 566–571, figs. 3*).—Descriptions of apparatus and details of operations and results.

Action of light on bacteria and fungi, H. M. WARD (*Chem. News, 70 (1894), No. 1824, pp. 228–230; No. 1825, pp. 241–244*).—A lecture delivered at the Royal Institution of Great Britain.

On the production of gaseous formic aldehyde for disinfection, R. CAMBIER and A. BROCHET (*Compt. Rend., 119 (1894), No. 15, pp. 607–609*).

The antiseptic properties of formol (formic aldehyde), A. TRILLO (*Compt. Rend., 119 (1894), No. 14, pp. 563–565*).

ZOÖLOGY.

Pocket gophers and moles, C. L. NEWMAN (*Arkansas Sta. Bul. 28, pp. 108–113*).—Notes on the life history and damage caused by pocket gophers (*Geomys breviceps*), with accounts of the methods employed in destroying them. Corn, rye, and peas soaked in strychnin were put into the burrows, and cotton or rags saturated with bisulphid of carbon were introduced into the holes and the openings closed with earth, but with small success. Steel traps buried in the bottom of the burrows were found much more effective.

Moles were caught by locating the points where they were working, pressing in the freshly made burrows on each side of the animals and throwing them out of the ground with a sweep of a spade

METEOROLOGY.

On protection against night frosts, H. E. HAMBERG (*Kgl. Landt. Akad. Handl. Tidskr., 33 (1894), pp. 125–127*).—This is a synopsis of a paper delivered before the Royal Swedish Agricultural Academy and treating mainly of the investigations of Lemström and Homén on this subject.

Lemström's work has been summarized (E. S. R., 6, p. 660). Homén attempted to determine quantitatively the amount of heat lost through nocturnal radiation, viz, the cooling of the air and the ground, and the heat required for the formation of dew. He found that the amounts thus lost during the night are very considerable; under otherwise similar conditions clayey and sandy soils have a greater conductibility of heat than marshy soils. Almost twice as much heat is lost from the former class of soils as from the latter. They can, however, better replace the loss of heat and therefore better withstand frost than the latter.

Homén also states that crops differ greatly in their susceptibility to frost. The same holds true with different parts of the same plants, and with the same plants at different stages of growth. More juicy plants or parts of plants are, as a rule, more susceptible than plants of a harder structure; there are, however, so many exceptions to this rule that susceptibility to frost must be considered dependent on the specific, but still unknown, nature of each plant as developed by heredity through innumerable generations. According to the author crops are able to stand temperatures of −2 to −3° C. (28.4 to 26.6° F.) without injury.—F. W. WOLL.

Meteorological observations, C. S. PHELPS (*Connecticut Storrs Sta. Rpt. 1893, pp. 116–118*).—The results of observations on rainfall during the period from May to October, inclusive, at 22 localities in the State; and on temperature, pressure, humidity, cloudiness, and precipitation during each month of the year at the station are reported in tables.

The average total precipitation for the State during 6 months (May–October) was 24.32 in.

The following is a summary of the observations made at the station: *Barometer* (in.), highest, 30.79; lowest, 29.04; mean, 30.03; *temperature* (degrees F.), highest, 91.1 (June); lowest, −6, (January); mean, 45.1; *humidity*, mean, 76.8; *precipitation* (in.)—total, 46.65; number of days on which precipitation was 0.01 in. or more, 121; number of cloudy days, 107.

"The rainfall for the year, as measured at the station (46.65 in.), is a little below the average of the State. . . .

"The rainfall was deficient during just that portion of the year when most needed by the greater part of our common farm crops. This condition caused great injury to such crops as corn, potatoes, grass, and tobacco. . . .

"The spring opened a little later than usual. The last damaging frost occurred May 8. The summer months were characterized by frequent drying winds and a moderate temperature, with light rainfall till after the middle of August.

"Light frost appeared on low ground September 3. The first killing frost occurred October 17. This gave a growing season of 161 days since the last damaging frost in the spring, while the average growing season, since the station began its observations in 1888, is 145 days."

Report of the North Carolina State Weather Service for 1893, H. B. BATTLE, C. F. VON HERRMANN, and R. NUNN (*North Carolina Sta. Rpt. Met. Div. 1893, pp. 63*).—The chief meteorological features

of the year are shown in notes and tables compiled from the reports of 67 observers in North Carolina and the adjacent territory of Virginia, Tennessee, and South Carolina. The tables show (1) the annual summary for the year by months; (2) annual summaries for stations having complete or nearly complete records throughout the year; (3) the highest, lowest, and mean barometer for each month of the year; (4) the maximum, minimum, and mean temperature for each month of the year; (5) the monthly precipitation and number of rainy days; (6) prevailing wind directions; and (7) comparisons of meteorological conditions for the past 13 years, 1881–'93. Miscellaneous data relating to snows, frosts, local storms, etc., which could not be placed in tabular form, are also given, together with lists of observers and stations in operation at the end of 1893, of weekly crop correspondents, of stations receiving weather forecasts by telegraph or mail, and of publications of the weather service during the year.

Meteorological observations in Arkansas, 1893 (*Arkansas Sta. Bul. 28, p. 114*).—A table taken from the State Weather Service report shows the maximum, minimum, and mean temperature and rainfall for each month of the year, and the dates of first and last killing frosts.

Meteorological records, G. E. MORROW (*Illinois Sta. Bul. 34, pp. 418, 419*).—This is a summary of observations on rainfall and temperature for the 6 years ending August 31, 1894.

Rainfall record, W. H. HEILEMAN (*Iowa Sta. Bul. 25, p. 48*).—A record of the rainfall at the station from September 1, 1893, to March 1, 1894.

Meteorological observations at Massachusetts Hatch Station, C. D. WARNER and F. L. WARREN (*Massachusetts Hatch Sta. Met. Buls. 67, 68, and 69, pp. 4 each*).—Daily and monthly summaries of observations during July, August, and September at the observatory of the station

Meteorological summaries for North Carolina, July and August, 1894, H. B. BATTLE, C. F. VON HERRMANN, and R. NUNN (*North Carolina Weather Service Buls. 58, pp. 17, maps 2; 59, pp. 16, maps 2*)—The usual summaries of observations by the State Weather Service, coöperating with the Weather Bureau of this Department.

Monthly Weather Review (*U. S. Dept. Agr., Weather Bureau, Weather Review, 22 (1894), No. 4, pp. 43, charts 5; No. 5, pp. 42, charts 4; No. 6, pp. 38, charts 4*).—These numbers are devoted to the usual topics.

WATER—SOILS.

Rhode Island soils, H. J. WHEELER and B. L. HARTWELL (*Rhode Island Sta. Bul. 28, pp. 15–33*).—The comparative reliability of chemical analysis and soil tests with fertilizers for determining the fertilizer requirements of soils are briefly discussed, and analyses of 7 samples of soil from fields in different parts of the State which had long been used as pastures are reported. Soils of this character were selected on the supposition that they would yield results comparable with those obtained on virgin soils, for which Hilgard has laid down rules for interpreting the results of analysis.[1] It was found, however, that Hilgard's basis of interpretation would not apply to Rhode Island soils.

[1] Jour. Amer. Chem. Soc., 16 (1894), No. 1, p. 34.

"Soil tests with fertilizers have shown that the soil of Kingston Plain can not be profitably cultivated without immediate resort to phosphatic fertilizers, though the contrary would be inferred from the percentage of phosphoric acid and lime as shown by the regular method of chemical analysis, provided the results are interpreted upon Hilgard's basis for virgin soils. It appears, therefore, that soil tests with fertilizers furnish, at present, more reliable data for arriving at the actual needs of our soils than does the ordinary method of chemical soil analysis. . . .

"One important point has been brought out with great emphasis during our examinations of the soil of Kingston Plain, viz, the importance of recognizing the presence or absence of any considerable degree of soil acidity. At least among American writers the opinion apparently prevails that an injurious degree of soil acidity is practically never met with except in bogs or wet, marshy lands, sometimes referred to as 'sour, wet lands.' . . .

"The fact that a degree of soil acidity which is highly detrimental to certain agricultural plants is liable to exist even in the case of naturally well-drained and upland soils has not, we believe, been heretofore sufficiently recognized, and chemical tests for the same have been too frequently omitted in the course of soil examinations. . . .

"Some reports which have come to us of inability to grow successfully rutabagas, onions, and more especially beets, spinach, lettuce, etc., even when amply fertilized, may find their explanation along the line of too great soil acidity. . . .

"In case of acid soils (*i. e.*, soils which when moistened impart to blue litmus paper a red color, which persists after drying) an application of caustic or carbonate of lime, not gypsum or plaster, has always proved to be an efficient remedy."

The use of lime in form of good marl, wood ashes, leached and unleached, and air-slacked lime is believed to be more economical in actual practice than that of other alkaline carbonates, or of barnyard manure in liberal doses, although these are believed to be effective means of correcting acidity.

Alkaline soils of Canada, F. T. SHUTT (*Canada Exptl. Farms Rpt. 1893, pp. 135–140, dgms. 3*).—Analyses of 4 samples of alkaline soil from Manitoba confirm the conclusions from previous examinations (E. S. R., 4, p. 433; 6, p. 124) "that sulphate of magnesium, and not sulphate or carbonate of sodium (the usual form of alkali), was, in all probability the cause of the barrenness of the soil."

In order to determine an effective means of correcting this alkali a series of pot experiments was commenced in 1892 and continued in 1893. The results, which are also shown in diagrams, were as follows:

"In soils to which 5 per cent of magnesium sulphate (Epsom salts) had been added the germination of the seeds was always greatly retarded. Many of the seeds sown never produced plants that appeared above the surface of the ground, while those which came up lacked robustness, made but little growth, and then died. All the experiments proved that magnesium sulphate to the extent of 5 per cent in the soil is most disastrous to plant life.

"In another series sufficient carbonate of lime, in the form of powdered chalk, was mixed with the soil to theoretically convert, after the lapse of time, the 5 per cent of magnesium sulphate into an inert and insoluble compound. In these pots germination was also delayed, though not so long as in the former series, and a greater percentage of plants grew, though their development was not equal in vigor or luxuriance to those in the potting soil. To a certain extent carbonate of lime had counteracted the deleterious effects of the magnesium sulphate.

"Further experiments were then commenced, in which lime was substituted for

carbonate of lime in the soil containing the 5 per cent of magnesium sulphate. The reaction of the lime in rendering the magnesium salt insoluble would be quicker, and better results were therefore expected than in the foregoing series. This prediction proved correct. Though germination was somewhat retarded, a greater percentage of plants grew and attained a larger and healthier growth than in the soil containing the antidote, carbonate of lime. It was evident that the lime proved the more efficacious of the two."

On the action of common salt, phosphates, and nitrate of soda in rendering soluble the potash of the soil, N. PASSERINI (*Atti. R. Accad. Economico-agraria Firenze, 72 (1894), pp. 15–25*).—The investigations of Dehérain and of Cossa on the effect of gypsum on the solubility of potash in the soil led the author to study the effects of the above-named fertilizers on the solubility of potash, lime, and magnesia. December 17, 1892, 500 gm. lots of earth very rich in potash (1.23 per cent K_2O) were placed in glass vessels washed with boiling hydrochloric acid; with this soil there had been previously mixed 20 gm. of either common salt, monocalcic phosphate, tricalcic phosphate, or nitrate of soda. In one series of vessels the earth was kept moist, in another dry, and checks were employed. Dust, but not air, was excluded. Analyses of the mixtures were made from July to September, 1893. The solubility in boiling water was determined, using 1 liter of water in washing 500 gm. of soil.

When common salt was added to the soil each kilogram of the latter when kept moist contained 0.1831 gm. of soluble potash in excess of that of the earth without salt, and an excess of 0.0725 gm. when the treated soil was kept dry. Thus in 8,000,000 kg., which the author estimates as the average weight of the active stratum of a cultivated soil of 1 hectare, he states that there had been made soluble by means of common salt in a humid soil 1,465 kg. of potash per hectare, in a dry soil 580 kg. of potash.

Attention is called to the fact that the proportion of fertilizer to soil, 1 to 25, is much greater than is possible in field practice; hence with smaller amounts of fertilizer we should expect less activity in converting insoluble potash into soluble forms.

Common salt also rendered soluble a large quantity of lime and magnesia, although the solubility of these substances was not increased by keeping the soil humid as compared with keeping it dry. The author states that common salt could not be expected to produce good results on soils poor in potash. The injurious effects sometimes noticed he attributes to its corrosive influence on plant roots, or to its action in suspending nitrification, as, according to Dehérain, 0.4 per cent of salt is sufficient to prevent this process.

Only the purest monocalcic phosphate was used in these experiments. In a moist soil it made soluble 0.0125 gm., and in a dry soil 0.0099 gm. of potash in every kilogram of soil; or in every 8,000,000 kg., 100 kg. and 79.2 kg., respectively.

When tricalcic phosphate was used with dry earth the solubility of

potash was not increased at all, and but slightly when the mixture was kept moist. That superphosphate often produces better results than raw phosphate the author regards as sometimes due to the fact that the former renders soluble in the soil a larger amount of potash than the latter.

When nitrate of soda was added and the earth kept dry the increase in the soluble potash was 0.0971 gm.; when moistened, 0.1433 gm. in a kilogram of soil. These quantities are equivalent to 777 and 1,146 kg., respectively, in 8,000,000 kg. of soil. The nitrate of soda also rendered soluble a large quantity of lime and magnesia. Of all the fertilizing materials tested nitrate of soda was most active in making potash, lime, and magnesia soluble. For soils rich in potash, as in strong clay soils and in others, the author considers it unnecessary to apply potash fertilizers when superphosphate and nitrate of soda are employed as fertilizers.

Soil temperatures, T. Cannelin (*Mustiala Agl. College Rpt. 1892, pp. 50–64*).—Observations of soil temperatures were made during 1892 in 3 different places and at 3 different depths in the soil. The stations were located as follows: (1) Near a marsh on moist, gravelly soil which had been in pines for 130 years; (2) on a clearing of about 7½ acres, about 1,000 ft. from station 1, sparsely grown with small pine, fir, and birch; and (3) on a drier soil in 40-year-old birch, aspen, and fir.

The temperature was observed at depths of 0.5, 1, and 2 meters, observations being taken every day at 9 a. m.

The monthly averages of the 9 different temperature readings are shown in the following table:

Average readings of soil thermometers.

Month.	Station 1.			Station 2.			Station 3.		
	2 meters.	1 meter.	½ meter.	2 meters.	1 meter.	½ meter.	2 meters	1 meter.	½ meter.
	Deg. C.	*Deg. C.*	*Deg. C.*	*Deg. C.*	*Deg. C.*	*Deg. C.*	*Deg. C.*	*Deg. C.*	*Deg. C.*
January	3.50	1.84	0.78	3.41	2.49	1.47	3.87	2.36	0.97
February	2.92	1.23	0.12	2.57	1.49	1.22	3.23	1.71	0.20
March	2.26	0.97	0.17	2.99	1.57	1.03	2.92	1.27	0.01
April	2.02	0.80	0.25	2.02	1.50	1.02	2.51	1.20	0.30
May	2.26	0.80	0.35	2.38	2.58	3.96	2.17	1.20	0.82
June	2.14	3.48	3.75	4.77	7.16	9.61	3.99	4.54	6.72
July	4.49	6.16	8.76	6.97	9.50	12.54	6.08	7.41	9.66
August	6.75	(1)	9.89	8.55	11.04	12.83	7.30	8.38	10.31
September	7.30	....	9.00	9.03	10.40	10.82	8.30	8.44	9.49
October	7.05	....	6.19	7.73	8.15	7.35	7.80	7.33	6.86
November	6.50	....	3.77	6.19	5.38	4.59	6.26	5.40	3.82
December	5.80	....	1.41	4.67	3.41	2.17	5.18	3.42	1.49
Average for year	4.41	....	3.70	5.04	5.38	5.71	4.96	4.38	4.22

[1] Thermometer out of order.

—F. W. WOLL.

Analyses of well waters, F. T. Shutt (*Canada Exptl. Farms Rpt. 1893, pp. 151–154*).—Tabulated analyses with reference to sanitary condition of 34 samples of well water from different parts of the Dominion of Canada.

A simple method of detecting fecal contamination in drinking water, H. Nordlinger (*Pharm. Central Halle, 1894, No. 8; abs. in Ztschr. landw. Ver. Hessen,*

1894, No. 23, pp. 190, 191).—It is claimed that by using saprol as a disinfecting agent in closets and sinks contamination of the water supply from these will be quickly detected by the characteristic taste of saprol, which is noticeable in a solution of 1 part of saprol to 2,000,000 of water.

A new apparatus for taking samples of water from different depths for bacteriological examination, C. GONCALVES (*Centbl. Bakt. und Par., 16, p. 257; abs. in Chem. Centbl., 1894, II, No. 16, p. 698*).

Exhaustion and restoration of soil fertility, W. L. HUTCHINSON (*Mississippi Sta. Bul. 29, pp. 10–16*).—The amounts and value of the nitrogen, potash, and phosphoric acid removed from the soil by 14 of the more common Southern farm crops are tabulated and discussed, and means of conserving and restoring fertility by preventing surface washing and leaching, by the use of fertilizers and soil improvers, such as lime and gypsum, by promoting nitrification, and by rotation of crops are described.

Brief notes on the physical and chemical properties of soils, R. WARINGTON (*London: Chapman & Hall*).

The amount and rôle of lime in arable soil, A. BERNARD (*Rev. Agric., 8 (1894), No. 7, pp. 154–160; No. 9, pp. 199–206*).

Influence of irrigation on the fertility of soils, F. L. WATROUS (*Amer. Agr., middle ed., 1894, Oct. 13, p. 186*).

Recent experiments in soil inoculation (*Landw. Centbl. Posen, 1894, No. 40; Wochenschr. pom. ökon. Ges., 24 (1894), No. 20, pp. 273, 274*).

Analyses of Canadian soils, F. T. SHUTT (*Canada Exptl. Farms Rpt. 1893, pp. 129–135*).—The factors upon which soil fertility depends and the essential fertilizing element of soils and fertilizers are briefly discussed, and analyses and descriptions are given of 16 samples of soil from different parts of the Dominion of Canada.

On the composition of the fen soils of South Lincolnshire, R. H. WILSON (*Chem. News, 70 (1894), No. 1818, pp. 153, 154*).

The soils of Norway, A. HELLAND (*Bul. 9 Geolog. Survey of Norway. Christiania: 1893, pp. VIII+464*).—This contains an English summary of the contents.

FERTILIZERS.

Fertilizers and their use, S. M. TRACY (*Mississippi Sta. Bul. 29, pp. 17–32*).—This is a review based upon the results of 6 years' experimenting under the supervision of the station on "the 4 soils most common in the State: The sandy clay region of the northwest, the black prairie of the northeast, the yellow-clay loam of the central region, and the sandy pine-woods soil of the southern part of the State." The topics discussed are (1) the general principles of fertilizing; (2) the value, management, and use of barnyard manure; (3) composts; (4) cotton seed as a fertilizer; (5) green manuring; (6) marl; and (7) commercial fertilizers.

The conclusions reached are in brief as follows: Restoration of worn soils must be gradual, and should be brought about principally by green manuring, supplemented by the use of a comparatively small amount of commercial fertilizers. Lespedeza, top-dressed with cotton-seed meal and turned under at the end of the second year, is best adapted to the restoration of very poor clay soils. To more fertile soils cowpeas, fertilized with cotton-seed meal, acid phosphate, or gypsum, are better suited. The cowpea is also the crop best adapted to the

sandy pine-woods soil. Melilotus, plowed under at the end of the second season, is the best green manure for soils underlaid with lime and for the black prairie soils. For simply maintaining fertility, red clover or alfalfa may be used. The green manuring should be supplemented by the carefully saved and protected barnyard manure, and chemical fertilizers should be used "to supply known deficiencies in the soil rather than as the principal fertilizer."

Analyses of fertilizing materials and home-mixtures, and the experience of farmers with home-mixtures, E. B. VOORHEES (*New Jersey Stas. Bul. 102, pp. 19*).—A schedule of trade values for 1894 is given, and the average prices per pound of fertilizing constituents, as calculated from manufacturers' retail prices and from the State schedule of prices, are tabulated and discussed. Tables give the analyses and valuations of 114 samples of fertilizing materials, including nitrate of soda, sulphate of ammonia, dried blood, dry ground fish, cotton-seed meal, ground bone, tankage, boneblack, bone ash, South Carolina rock and other mineral phosphates, muriate of potash, sulphate of potash, kainit, and home-mixtures.

The examination of 10 home-mixtures showed them to be generally superior to manufacturers' mixtures in mechanical condition, composition, and cost.

The experience of 60 farmers in home-mixing is summarized, and is overwhelmingly in favor of the practice.

The comparative value of the nitrogen of barnyard manure and of green manures, J. KÜHN (*Ztschr. landw. Cent. Ver. Sachsen, 1894, Nos. 2, 3, 4, 5, 6; abs. in Chem. Centbl., 1894, II, No. 10, p. 493*).—A review is given of the experiments of Wagner, which showed as the average of 3 years' results that as regards effectiveness the different forms of nitrogen stood as follows: Nitrate of soda 100, nitrogen in stable manure 25, nitrogen in green manures 65. Under other conditions the figures for the last two were 45 and 70, respectively. The results are still more unfavorable to the manure when only the action during the first year is considered. In that case the figure for nitrogen in stable manure was 11, and that for nitrogen in green manures 62. It is maintained that, although it is a well-known fact that barnyard manure is slow of action, it is contrary to all agricultural experience to suppose that the figures for the first year should be so low, and it is therefore suggested that there must be some error in Wagner's experiments.

The author obtained similar results with leached manure. With this material he found the following figures: During the first year 11, the second year 25, and the fifth year 30. These results indicate that Wagner's figures are unreliable for normal manure, and serve to illustrate the unsatisfactory results that will be obtained if manure is improperly managed.

An experiment to determine the amount of manure made by a cattle beast during the successive periods of its growth, C. A. ZAVITZ (*Ontario Agl. Col. and Exptl. Farm Rpt. 1893, pp. 121–123*).—The amounts of food consumed, litter used, and manure produced by a calf during the first 3 years of its life are reported.

The results, calculated to 6-month periods, are given in the following table:

Manure produced by a calf during the first 3 years of its life.

	Amount of straw used as bedding.	Total amount of manure produced.	Amount of manure produced, less the straw.
	Tons.	*Tons.*	*Tons.*
First 6 months	0.43	1.95	1.53
Second 6 months	1.01	5.00	3.99
Third 6 months	1.17	5.16	3.99
Fourth 6 months	1.35	6.08	4.73
Fifth 6 months	1.22	5.77	4.55
Sixth 6 months	1.20	5.68	4.49
Whole period (3 years)	6.38	29.64	23.28

A sample of manure taken from the stall near the close of the experiment contained moisture 53.51 per cent, nitrogen 0.63 per cent, phosphoric acid 0.83 per cent, potash 1.94 per cent. Reckoning the value of the manure from this analysis on the basis of valuation used for commercial fertilizers, the manure produced during the 3 years was worth $118.57.

Commercial fertilizers, H. A. HUSTON and W. J. JONES, Jr. (*Purdue Univ. Spec. Bul. 1894, Aug., pp. 11*).—Notes on the extent of the fertilizer trade in Indiana in 1890, on the character of the fertilizers offered for sale in the State, on the draft of different crops upon soil fertility, on the use of fertilizers, and on valuation, accompanied by tabulated analyses and valuations of 312 samples of fertilizers legally on sale in the State.

"The estimated sales of commercial fertilizers in Indiana during the year 1893 amount to 38,000 tons, an increase over the sales in 1892 of 3,000 tons. This 38,000 tons of fertilizer consisted of 14,000 tons of bone, raw and steamed; 18,000 tons of 'complete' fertilizer, that is, fertilizer containing nitrogen, phosphoric acid, and potash; 4,000 tons of ammoniated phosphates; 1,000 tons of phosphate and potash; and 1,000 tons of plain superphosphate. The aggregate selling price would amount to over $1,000,000.

"A change is taking place in the character of the fertilizers sold in the State. This change consists of a relative increase in the amount of phosphoric acid contained in the fertilizers and a relative decrease of nitrogen and a relative decrease of potash. The total quantity of phosphoric acid contained in the fertilizers sold in the State in 1893 was 12,900,000 lbs., the total quantity of ammonia was 2,300,000 lbs., and the total quantity of potash 770,000 lbs. If we compare these quantities with the quantities sold in 1889 we find that there has been a relative increase in the amount of phosphoric acid of 10 per cent, a relative decrease in the amount of ammonia of 3 per cent, and a relative decrease of potash of 9 per cent. . . .

"Information is not at hand to determine the cause of the change in the relative quantities of nitrogen, phosphoric acid, and potash used in the State."

It is estimated that the 5 leading crops (corn, wheat, oats, timothy, and clover) grown in Indiana take from the soil $104,603,700 worth of fertilizing constituents, while only $1,501,680 worth, or less than 1½ per cent, of these constituents are returned to the soil in the form of fertilizers.

Solubility of phosphoric acid in bone meal, L. GEBEK (*Ztschr. angew. Chem., 1894, No. 7, p. 193*).—The author found 80 per cent of the phosphoric acid soluble in citrate solution by Wagner's method. Removing fat did not increase solubility. Removal of gelatin reduced solubility to 70 per cent. Ignition completely changed the character of the phosphate. The results in general indicate that only a small amount of the phosphate of bone is in tribasic form.

Field experiments with fertilizers, C. S. PHELPS (*Connecticut Storrs Sta. Rpt. 1893, pp. 119–125, 136–139*).—In continuation of coöperative experiments commenced in 1888 (E. S. R., 5, p. 574), soil tests with fertilizers were made under the supervision of the station on 6 farms in different parts of the State. In most cases the results were vitiated by drought, and are therefore reported in tabular form without comment.

In one of the experiments, which has been conducted for 3 years on a light alluvial loam, deficient in organic matter and worn by previous cropping without manure, the results indicated that it is necessary to supply such soils with an abundance of organic matter containing nitrogen in order to get the full benefit of mineral fertilizers, and that on soils of this character soluble phosphates in absence of available nitrogen may diminish the yield by hastening maturity and thus shortening the life of the plant.

It was incidentally observed that the percentages of water in corn (ears) grown in the different experiments varied so widely as to render field weights unreliable as measures of the yields. For this reason all yields of ears are calculated to 11 per cent of moisture in the report.

Field experiments with fertilizers in Great Britain (*Bd. Agr. Rpt. Distrib. Grants for Agl. Education in Great Britain 1893–94, pp. 41–66*).—These include experiments on grass and pasture lands, potatoes, and Swedes (ruta-bagas) in different parts of Anglesey, Carnarvon, and Cardigan counties, Wales, and Northumberland and Durham counties, England.

Experiments on pasture lands (pp. 41, 55–64).—In experiments near Amlwch, North Wales, during one season superphosphate gave better results than slag, and a mixture of nitrate of soda with the different phosphates proved better than the phosphates alone. No potash fertilizers were tested.

In experiments on 5 different farms in Northumberland the best average results were obtained from the use of mixtures containing all three fertilizing constituents. Sulphate of ammonia proved superior

to nitrate of soda, and superphosphate superior to slag. Kainit used alone was injurious rather than beneficial.

The results of experiments at Aberystwyth in Cardigan, Wales, confirmed the above results in some respects and contradicted them in others. Nitrate of soda was more effective than sulphate of ammonia, probably on account of the dry season, and slag produced better results than superphosphate, due, it is believed, to a deficiency of lime in the soil. Nitrogenous manures "were more directly profitable" than phosphates. Phosphates were most effective in combination with nitrogenous manures.

Experiments on potatoes (pp. 44, 45).—The results of experiments in North Wales on a "poor free-working soil with clay subsoil" indicated that sulphate of ammonia was superior to nitrate of soda, and that barnyard manure alone was a very effective fertilizer for potatoes. The highest yield was obtained with the following mixture. Barnyard manure, 15 tons; superphosphate, 3 cwt.; sulphate of potash, 2 cwt., and sulphate of ammonia, 1 cwt.

Experiments on ruta-bagas (pp. 42–44, 49–54).—Experiments on 6 different soils—good loam (2), medium loam, fairly strong soil, strong clay, and light loam with underlying gravel—in Anglesey and Carnarvonshire, Wales, gave results indicating that phosphoric acid is the predominant element in a fertilizer for ruta-bagas, that superphosphate and slag are about equally effective, and that either is superior to dissolved bone.

In experiments on 9 different farms in Northumberland, England, the best proportion of nitrate of soda in a fertilizer for ruta-bagas seemed to be 2 cwt. of nitrate to 5 cwt. of superphosphates per acre, and 2 cwt. of kainit; sulphate of ammonia proved more effective than nitrate of soda, and a mixture of the two (56 lbs. of nitrate and 43 lbs. of sulphate) more effective than either alone; and applications of kainit in connection with the other manures were profitable except near the seacoast, where the land had been manured with seaweed or was subjected to the sea spray. The beneficial effect of 16 loads of manure applied in the drill was not increased by the addition of artificial fertilizers, while additions of nitrate of soda and superphosphate to manure applied in the fall largely increased the yield. Spring applications of barnyard manure gave better results in every case than autumn applications. It was further observed in these experiments that nitrate of soda increased the percentage of moisture in the roots from 90.23 per cent to 91.06 per cent, while kainit decreased it from 90.22 per cent to 89.89 per cent.

The results of experiments at 6 different points in Durham County confirm in many respects those obtained in Northumberland. Phosphoric acid was clearly shown to be the predominant element in a fertilizer for ruta-bagas on these soils. In comparative tests of both equal money values and equal amounts of phosphoric acid in form of slag and

superphosphate the superiority of the superphosphate was clearly shown. Kainit was profitable in both light and heavy soils, except when used in connection with barnyard manure.

Manures and fertilizers, H. C. WHITE (*Georgia Sta. Bul. 22, pp. 22*).—The nature and use of fertilizers are discussed under the heads of (1) mechanical manures, including all organic manures, lime, marl, etc., and (2) concentrated fertilizers, including the various commercial sources of potash, phosphoric acid, and nitrogen. The principles involved in compounding fertilizers are explained and illustrated.

The fertilizer industry (*Amer. Fert., 1 (1894), No. 1, p. 39*).—Statistics from the Census.

Growth of the fertilizer industry, W. L. RASIN (*Amer. Fert., 1 (1894), No. 1, pp. 5–8, pl. 1*).

Progress in the use of artificial manures, E. B. VOORHEES (*Amer. Fert., 1 (1894), No. 1, pp. 21–23*).

On the choice and use of artificial manures, F. B. GUTHRIE (*Agl. Gaz. N. S. Wales, 5 (1894), No. 8, pp. 575–577*).—Nitrogenous and phosphatic manures are discussed.

Salient points in the use of fertilizers, H. J. PATTERSON (*Amer. Fert., 1 (1894), No. 1, pp. 24–26*).

The taking up of nourishment by plants, KÖNIG (*Verhandl. Ges. deut. Naturforsche und Aerzte, 1893, II, pp. 122–124; abs. in Chem. Centbl., 1894, II, No. 10, p. 480*).—Experiments during 2 years with barley and beans grown on artificial soils, to which varying amounts of phosphoric acid, nitrogen, and potash in soluble and insoluble forms were added. No conclusions are drawn.

The importance of potash for plant growth, C. VON FERLITZEN (*Sv. Mosskultur. Fören. Tidskr., 1894, July; Landmandsblade, 27 (1894), pp. 522–524*).

Farming with artificial fertilizers, L. ENGELMANN (*Ztschr. landw. Ver. Bayern, 1894, May, pp. 377–382*).

Evolution of a formula (*Amer. Fert., (1894), No. 2, pp. 83–85*).

The utilization of peat as litter and as fertilizer (*Bul. Min. Agr. France, 30 (1894), No. 5, pp. 440–447*).—The results of a study of the extent and value for litter and for fertilizer of the peat deposits in different parts of France are reported.

The loss of nitrogen in barnyard manure and means of lessening it, HESS (*Landw. Wochenbl. Schles. Holst., 1894, No. 24, pp. 374, 375*).

On the economy of using the sewage of Mainz for fertilizer, MULLER (*Ztschr. landw. Ver. Hessen, 1894, No. 28, pp. 227, 228; No. 29, pp. 236, 237*).

Fertilizers and stable manure (*Amer. Fert., 1 (1894), No. 1, pp. 30, 31*).

Green manures and fertilizers (*Amer. Fert., 1 (1894), No. 2, pp. 105, 106*).

Manures, green and artificial, A. L. KENNEDY (*Amer. Fert., 1 (1894), No. 3, pp. 156, 157*).

Wood ashes and their use, T. GREINER (*Oswego: Munroe, Lalor & Co.; noticed in Cult. and Country Gent., 1894, Oct. 18, p. 751*).

Dried blood and other ammoniates, R. L. WENDLER (*Amer. Fert., 1 (1894), No. 2, pp. 80–82*).—Discusses dried blood, hoof meal, tankage, raw-bone meal, steamed bone, horn, etc.

Menhaden fish manure, S. PEACOCK (*Amer. Fert., 1 (1894), No. 4, pp. 213–218, fig. 1*).

The cotton-seed meal industry, L. A. RANSON (*Amer. Fert., 1 (1894), No. 1, pp. 26–28*).

Cotton-seed meal, W. C. ADAMS (*Amer. Fert., 1 (1894), No. 4, pp. 219, 220*).

Tankage and other sources of ammoniates, T. H. WHITE (*Amer. Fert., 1 (1894), No. 1, pp. 19, 20*).

Ammonia sulphate from the coke industry, L. K. FRANKEL (*Amer. Fert., 1 (1894), No. 2, pp. 78, 79*).

Exploitation and purification of nitrate of soda in Chile, J. BUCHANAN (*Jour. Pharm. et Chim., 30 (1894), ser. 5, No. 9, pp. 417–425*).

Deposits of nitrates in Colombia, CARACRISTI (*Jour. Pharm. et Chim., 30 (1894), ser. 5, No. 9, pp. 425–427*).

The nitrate clays of upper Egypt, E. SICKENBERGER (*Chem. Ztg., 18 (1894), No. 61, pp. 1157, 1158*).—Notes on the occurrence and fertilizing value of these clays; on the manner of their formation; and on their employment in Egyptian agriculture.

Cheaper nitrogen and cheaper phosphoric acid, P. WAGNER (*Deut. landw. Presse, 21 (1894), No. 81, pp. 769, 770; No. 82, pp. 779, 780*).

The relative values of the different forms of phosphoric acid, P. WAGNER (*Deut. landw. Presse, 21 (1894), No. 81, pp. 769, 770; No. 82, pp. 779, 780*).

Phosphatic slag, L. GRANDEAU (*Jour. Agr. Prat., 58 (1894), No. 43, pp. 595, 596*).

Basic slag (*Amer. Fert., 1 (1894), No. 2, pp. 85–87*).

The production of slag in central Europe, MAIZIÉRES (*L'Engrais, 9 (1894), No. 44, pp. 1044, 1045*).

Redonda and its phosphates, F. W. MORSE (*Pop. Sci. Monthly, 1894, Nov., pp. 78–87*).

Muriate vs. sulphate of potash as a fertilizer (*Cult. and Country Gent., 1894, Oct. 18, p. 751*).

Field and pot experiments with different phosphates, E. CHUARD (*Chron. Agr., 7 (1894), No. 19, pp. 493–498*).

Fertilizer inspection and analysis in Alabama (*Alabama Dept. Agr. Bul. 57, pp. 84*).—This includes a general discussion of the sources and uses of fertilizers; notes on valuation; abstracts of State laws relating to fertilizers; a list of licenses granted up to August 1, 1894; a list of guaranteed analyses filed with the Commissioner of Agriculture; and tabulated analyses and valuations of 317 samples of fertilizing materials, including mixed fertilizers, acid phosphate, bone, tankage, cottonseed meal, bat manure, marl, mineral phosphates, muriate of potash, and kainit.

Commercial fertilizers and chemicals, R. T. NESBITT and G. F. PAYNE (*Georgia Dept. Agr. Bul. 29, pp. 109*).—This bulletin contains notes on valuation; articles on fertilizing watermelons, percentages of valuable fertilizing constituents in commercial fertilizers, cotton seed and its products, and some of the possibilities of Georgia soils; State laws relating to fertilizers, with comments; and tabulated analyses of 1,019 samples of fertilizing and other materials, including mixed fertilizers, bone, acid phosphate, cotton-seed meal, kainit, muriate of potash, dried blood, tankage, nitrate of soda, agricultural salt, soft phosphate, natural phosphates, basic slag, ores, limestone, lime, muck, ashes, and baking powders.

Commercial fertilizers, M. A. SCOVELL, A. M. PETER, and H. E. CURTIS (*Kentucky Sta. Bul. 51, pp. 24*).—The principles underlying the use of fertilizers are briefly discussed; terms used in stating results of analyses and the utility of the analyses are explained; the market prices of various fertilizing materials are given, with notes on valuation; and analyses and valuations of samples of 116 brands of fertilizers are reported.

Fertilizer analyses, R. C. KEDZIE (*Michigan Sta. Bul. 112, pp. 17*).—Brief remarks on the objects of fertilizer inspection and analysis; obligations of manufacturers regarding licenses; valuation; text of the State fertilizer law, with comments; and tabulated analyses of 78 samples of fertilizing materials.

Analyses of commercial fertilizers, T. J. EDGE and W. FREAR (*Pennsylvania State Bd, Agr. Spec. Bul., pp. 29*).—Text of the State fertilizer law, a schedule of trade values for 1894, with notes on valuation, and tabulated analyses of 544 samples of fertilizing materials collected from January 1 to August 1, 1894.

Analyses of commercial fertilizers, H. J. WHEELER and B. L. HARTWELL (*Rhode Island Sta. Bul. 28, pp. 34–42*).—A schedule of trade values of fertilizing ingredients, with notes on valuation, and tabulated analyses and valuations of 40 samples

of fertilizing materials, including mixed fertilizers, bone, nitrate of soda, muriate of potash, sulphate of potash, kainit, and wood ashes.

Analyses of commercial fertilizers (*South Carolina Sta. Bul. 17, n. ser., pp. 32*).—A schedule of trade values, text of the State fertilizer law, and tabulated analyses and valuations of 234 samples of fertilizing materials, including ammoniated fertilizers, acid phosphates, cotton-seed meal, kainit, and nitrate of soda. Forty-five of these brands fell below the guaranty.

Fertilizer analyses in West Virginia, J. A. MYERS (*West Virginia Sta. Spec. Bul. 1894, Aug., p. 1*).—The results of examinations of 121 samples of fertilizing materials are reported.

Fertilizing materials, F. T. SHUTT (*Canada Exptl. Farms Rpt. 1893, pp. 140–146*).—Analyses, with descriptions of samples and discussion of fertilizing value of 34 samples of muck from different parts of the Dominion of Canada, 7 samples of mud from the maritime provinces, and 1 sample each of wood ashes, flue ashes, oat-hull ashes, and gypsum.

FIELD CROPS.

Experiments with carrots, F. T. SHUTT (*Canada Exptl. Farms Rpt. 1893, pp. 147, 148*).—Analyses were made of the parts of the roots growing above and below ground. Four white Belgian carrots, nearly half of which were above ground, were cut in two at the junction of the green and white portion. The results of analyses of these parts were as follows:

Analyses of portions of carrots growing above and below ground.

	In fresh material.						In dry matter.			
	Water.	Albuminoids.	Fat.	Nitrogen-free extract.	Fiber.	Ash.	Albuminoids.	Fat.	Nitrogen-free extract.	Ash.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Upper (green) portion	89.04	1.05	0.41	7.54	1.11	0.85	9.60	3.72	68.81	7.70
Lower (white) portion	90.70	0.75	0.21	6.65	0.93	0.76	7.97	2.31	71.51	8.17

"It may be concluded . . . that no material difference in food value exists between the two portions."

Preparation of soil for cotton, C. L. NEWMAN (*Arkansas Sta. Bul. 28, pp. 100–103*).—On a plat both plowed and bedded in February the yield of seed cotton per acre was 869 lbs., and on a plat plowed in February and bedded in May the yield was 901 lbs.; on plats without previous plowing the yield when bedded in February was 724 lbs., and when bedded May 3, 754 lbs. of seed cotton per acre. The result was perhaps influenced by the fact that Bermuda grass was more difficult to suppress on the unplowed than on the plowed plats.

Fertilizer experiments on cowpeas, C. S. PHELPS (*Connecticut Storrs Sta. Rpt. 1893, pp. 126–129, 136*).—This experiment was conducted on twelfth-acre plats which for 4 successive years had received the same fertilizer. The yields and the percentage composition of the crops on the different plats are tabulated.

The following table gives the yields per acre:

Yields of green fodder and of food materials in cowpea vines per acre.

	Green material.	Dry matter.	Protein.	Fiber.	Nitrogen free extract.	Fat.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Unmanured	10,875	1,816	334	370	821	63
160 lbs. nitrate of soda	10,960	1,863	317	370	905	64
320 lbs. dissolved boneblack	10,710	1,821	345	369	824	59
160 lbs. muriate of potash	11,680	1,986	393	404	849	69
160 lbs. nitrate of soda 320 lbs. dissolved boneblack	12,920	2,196	378	438	1,037	79
160 lbs. nitrate of soda 160 lbs. muriate of potash	13,335	2,267	363	513	1,021	78
320 lbs. dissolved boneblack 160 lbs. muriate of potash	15,790	2,684	534	605	1,101	96
160 lbs. nitrate of soda 160 lbs. muriate of potash 320 lbs. dissolved boneblack	16,210	2,755	496	614	1,174	98
12,000 lbs. stable manure 160 lbs. dissolved boneblack	15,795	2,685	515	575	1,176	95
16,000 lbs. stable manure	15,875	2,699	487	578	1,202	100

From the above table it may be seen that potash had the most marked influence in augmenting the yield of dry matter, while nitrogen was less effective. "Unlike the grasses, the legumes seem to be but little affected in their protein or nitrogen content by the addition of nitrogen in the fertilizers. Potash appeared to have the most marked influence [in augmenting] the percentage of protein in the crop."

Experiments with flax in Belgium, P. DE CALUWE (*Exposé Cult. Expér. Jard. Gand, 1892–'93, pp. 30–36*).—Experiments with varieties and a test of different forms of phosphoric acid. On flax, as on lupines, superphosphate in a dry season reduced the yield.

Native and introduced forage plants in South Dakota, J. H. SHEPARD and T. A. WILLIAMS (*South Dakota Sta. Bul. 40, pp. 208, pls. 58*).—Description, geographical distribution within the State, and chemical analyses of the following grasses, clovers, and miscellaneous forage plants:

Little blue stem (*Andropogon scoparius*), big blue stem (*A. provincialis*), bushy blue stem (*A. nutans*), Johnson grass, dwarf panic grass (*Panicum depauperatum*), small panic grass (*P. scoparium*), switch grass (*P. virgatum*), barnyard grass, old witch grass, bristly foxtail (*Setaria verticillata*), green foxtail, yellow foxtail, millet, Indian rice, Virginia cut grass (*Homalocenchrus virginica*), rice cut grass (*H. oryzoides*), sweet vernal grass, reed canary grass, purple beard grass (*Aristida purpurea*), feather bunch grass (*Stipa viridula*), porcupine grass, spiked Muhlenberg grass (*Muhlenbergia racemosa*), Mexican wood grass (*M. mexicana*), wood grass (*M. sylvatica*), timothy, meadow foxtail, wild water foxtail (*A. geniculatus aristulatus*), black mountain rice (*Oryzopsis melanocarpa*), Indian millet (*O. micrantha*), southern poverty grass (*Sporobolus vaginæflorus*), prairie grass (*S. cuspidatus*), wire grass (*S. heterolepis*), rough-leafed prairie grass (*S. asperifolius*), tickle grass (*Agrostis hiemalis*), redtop, Indian reed grass (*Cinna arundinacea*), blue joint, big sand grass (*Calamovilfa longifolia*), sand grass (*Calamagrostis confinis*), big crow's foot (*Eleusine coracana*), tall oat grass, cord grass, wild crab grass (*Schedonnardus paniculatus*), grama grasses (*Bouteloua* spp.), buffalo grass, slough grass (*Beckmannia erucæformis uniflora*), false buffalo grass (*Munroa squarrosa*), reed grass, spike grass (*Diplachne fascicularis*), slender meadow grass (*Eragrostis pilosa*), stink grass (*E. multiflora*), southern spear grass (*E. purshii*), early or prairie bunch grass (*Eatonia obtusata*), Eaton grass (*E.*

pennsylvanica), reed fescue (*Scolochloa arundinacea*), prairie June grass (*Kœleria cristata*), salt grass (*Distichlis spicata stricta*), orchard grass, false redtop or fowl meadow grass (*Poa palustris*), Kentucky blue grass, English blue grass, bunch spear grass (*P. arida*), wood meadow grass (*P. nemoralis*), floating meadow grass (*Panicularia fluitans*), fowl meadow grass or nerved manna grass (*P. nervata*), reed meadow grass (*P. americana*), sheep fescue, tall fescue, hard fescue, soft chess, rough brome grass, swamp chess (*Bromus ciliatus*), smooth brome grass, Schrader brome grass, slender wheat grass (*Agropyrum tenerum*), quack grass, western wheat grass (*A. glaucum occidentale*), bearded wheat grass (*A. caninum* and *A. unilaterale*), perennial rye grass, squirrel-tail grass, wild rye or lyme grass (*Elymus virginicus*), wild rye, Dennett grass (*E. striatus*), flat-stemmed tufted spike rush (*Eleocharis acuminata*), tufted spike rush (*E. obtusa*), common spike rush (*E. palustris*), meadow rush (*Scripus atrovirens*), river club rush (*S. fluviatilis*), sea club rush (*S. maritimus*), Hall rush (*S. hallii*), sharp-pointed rush (*S. pungens*), chestnut-colored sedge (*Cyperus erythrorhizos*), giant sedge (*Carex aristata*), dwarf sedge (*C. stenophylla*), late-fruited sedge (*C. retrorsa*), silvery-topped sedge (*C. siccata*), straw-colored sedge (*C. straminea*), narrow-fruited sedge (*C. sychnocephala*), upright sedge (*C. stricta*). fox sedge (*C. vulpinoidea*), bur reed (*Sparganium eurycarpum*), big-headed bog-rush (*Juncus nodosus*), slender bog rush (*J. tenuis*), Beckwith clover (*Trifolium beckwithii*), red clover, crimson clover, alsike, white clover, fenugreek, yellow melilot or yellow sweet clover, white melilot or sweet clover, goat's rue (*Galega officinalis*), wild vetch (*Hosackia purshiana*), alfalfa, sainfoin, burnet, giant spurry, knot weed (*Polygonum aviculare*), and upright knotweed (*P. erectum*).

The authors divide the State into 5 regions: (1) The Sioux Valley region, (2) the James River Valley region, (3) the Missouri River Valley region, (4) the Great Range region, and (5) the Black Hills region. The characteristic grasses of the Sioux Valley region are the blue stems, especially the big blue stem and the bushy blue stem. About 90 per cent of the native hay and 80 per cent of the pasturage is obtained from the 2 grasses just named, together with switch grass. Western wheat grass furnishes about 90 per cent of the native hay and most of the pasturage of the James River Valley region. Blue joint and the sand grasses are also very common here. The flora of the Missouri Valley region is varied. Western wheat grass furnishes the greater part of the hay in the Range region. Other specially important grasses in this region are blue grama and buffalo grass. The Black Hills region has a number of native species. Of the introduced or cultivated grasses Hungarian brome grass (*Bromus inermis*) has thus far been more satisfactory in the State than any other grass tested, having endured both the drought of summer and the severe weather of winter.

Timothy succeeded on rich and moist soil, but is not regarded as suitable for the drier parts of the State. Red fescue, sheep fescue, and hard fescue "are all hardy enough to stand the climate in the eastern part of the State, and probably also that of most localities east of the Missouri River or in the Black Hills. Tall fescue and meadow fescue give paying crops of hay on moist meadows. Kentucky blue grass, or June grass, as it is often called, is hardy in the Sioux Valley, and will probably do well in many other parts of the State. The native grasses which have shown themselves worthy of cultivation are western wheat grass, slender

wheat grass, blue joint, and reed canary grass." Alsike and white clover succeeded, but scarlet and mammoth clover proved too tender. With red clover success was variable. Alfalfa made a good growth, but suffered severely from a fungus disease. Other leguminous plants giving promise of value for forage were goat's rue, sand clover, esparcet, Hedysarum, and wild vetch (*Hosackia purshiana*).

The bulletin also contains explanations of chemical and botanical terms and analyses of the seed of 2 varieties of millet and of roller process wheat bran.

Experiments with forage plants in Belgium, P. DE CALUWE (*Exposé Cult. Expér. Jard. Gand, 1892–'93, pp. 42–44, 47–59*).—The plants tested were prickly comfrey, hairy vetch, winter vetch, spring vetch, Narbonne vetch, white vetch, millet, maize, oats; early, late, and extra late crimson clover; red clover, wild chicory, cabbage, endive, spurry, burnet, kidney vetch, radish, alsike clover, sainfoin, serradella, canary grass, white mustard, English and Italian rye grass, and sorghum. Of the 4 kinds of vetches, all sown July 27, hairy vetch yielded the largest amount of green forage. Kidney vetch and burnet proved resistant to frost.

Fertilizer experiments on Hungarian grass, C. S. PHELPS (*Connecticut Storrs Sta. Rpt. 1893, pp. 130–135*).—This experiment was made on the same field as was used during the preceding 3 years for similar experiments on mixed meadow grasses. Nitrogen, either in the form of nitrate of soda, sulphate of ammonia, or "ammonite," was applied at the rate of 25, 50, and 75 lbs. per acre in combination with 320 lbs. of boneblack and 160 lbs. of muriate of potash. Two plats received no nitrogenous materials, and 2 plats were unfertilized.

"There was a gradual increase in yield with the increased quantities of nitrogen used. The crop in general did not show a very marked increase from the use of fertilizers. This was doubtless due in part to the severe drought during July and the greater part of August. The experiment confirms those made on the field with meadow grasses in demonstrating the importance of nitrogenous fertilizers in the growth of grasses."

Analyses of the hay grown on the different plats are tabulated.

"The average percentage of protein in the water-free substance of the crop on the mineral plats was 8.87 per cent, on the plats with 25 lbs. of nitrogen 10.24 per cent, and with 75 lbs. of nitrogen 12.72 per cent. This illustrates the double value of nitrogen on the grasses. The yield has generally increased with the larger quantities of nitrogen used, and the protein, and hence the feeding value of the crop is considerably increased."

Experiments with grasses, C. A. ZAVITZ (*Ontario Agl. Col. and Exptl. Farm Rpt. 1893, pp. 110–117*).—From numerous experiments with grasses and clovers sown alone, both for meadows and for pastures, the following, in the order named, proved the most permanent among the valuable species:

"Meadow fescue, orchard grass, meadow foxtail, tall oat, and timothy. Those of less importance include hard fescue, red fescue, wood meadow, rough-stalked

meadow, sheep fescue, various-leaved fescue, fine-leaved fescue, tall fescue, and long-leaved fescue, and these probably possess permanency in the order named. Some of these in the list last mentioned have even greater power to endure than those in the list first mentioned.

"The varieties which in our experience have not shown much permanence are Italian rye, sweet vernal, crested dogstail, tall oat, perennial rye, creeping bent, and redtop, and they have been found wanting in permanency in the order named.

"In the tests conducted at this farm the clovers have been found durable in the following order, viz: Lucerne, alsike clover, yellow clover, white clover, and common red clover. Yellow clover, like white clover, does not seem able to hold its ground at the first in dense mixed grasses which are cut for hay, but as time goes on, and some of the grasses fail, the yellow clover appears to increase. When white clover is sown in mixtures of permanent grasses, and these are mowed for some years at the first rather than pastured, the clover seems to fail because of the smothering influence exerted by the stronger grasses; but where the grasses are pastured from the first it seems to have power to increase with the increasing age of the pastures. . . .

"*Lathyrus sylvestris* . . . does not seem to grow quickly enough to give it a foremost place among fodder plants in this country."

Directions for preparing the soil and for selecting mixtures for permanent pastures are given. Autumn sowing of grasses was found less suitable than spring sowing.

Culture of Lathyrus sylvestris, A. VON SOLEMACHER (*Ztschr. landw. Ver. Rheinpreussen, 11 (1894), No. 36, pp. 299, 300*).—After 10 years' experience with this plant the author concludes that by the choice of land comparatively free from weed seed and by crowding the plants, placing them 4 to 6 in. apart in rows 8 to 10 in. apart, hoeing, so generally recommended for this crop, can be dispensed with.

Analyses of legumes, F. T. SHUTT (*Canada Exptl. Farms Rpt. 1893, pp. 146, 147*).—The following analyses are given, together with botanical notes on the materials analyzed:

Analyses of legumes.

	In fresh material.						Calculated to water-free substance.				
	Water.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Ether extract.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Ether extract.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Lathyrus sylvestris (green)	79.65	1.53	4.52	6.60	6.50	1.20	7.52	22.23	32.46	31.72	6.07
Lathyrus venosus (hay)	7.11	7.37	14.06	32.47	34.10	4.89	7.93	15.13	34.95	36.72	5.27
Astragalus canadensis (hay)	9.46	6.02	10.75	33.45	38.78	1.54	6.66	11.87	36.95	42.79	1.73
Melilotus alba (hay)	9.30	5.31	11.75	43.24	27.70	2.70	5.65	12.91	47.67	30.79	2.98
Vicia americana (hay)	7.01	7.99	13.87	34.33	35.58	1.22	8.59	14.92	36.90	38.28	1.31

"*Lathyrus sylvestris* produced a thick mass of leafy stems nearly 4 ft. in height. . . . Our own experience in feeding it is as yet extremely limited. It appears that at first the cattle will not evince a fondness for it." *Lathyrus venosus* is described as a "free-growing, native, perennial pea . . . found on the Western plains, from which the sample

analyzed was obtained. There appears to be no statement on record as to its value as a fodder, though judging from the analysis it is well worthy of trial."

Astragalus canadensis is "a stiff, free-growing, vetch-like plant, with abundant foliage and spikes of greenish-yellow flowers. It occurs usually on river banks, and sometimes attains a height of 3 ft." The sender of the sample states that "cattle are particularly fond of it."

Lupines, CLAUSEN (*Landw. Wochenbl. Schles. Holst., 44 (1894), No. 39, pp. 539, 540*).—At the agricultural school at Heide, yellow, blue, and white lupines have been grown 3 years. In the latest of these experiments the yields of the 3 species at different dates on plats of the same size (area not stated), planted early in May, were as follows:

Yields of lupines at different dates.

Date.	Yellow lupine.	Blue lupine.	White lupine.
	Pounds.	*Pounds.*	*Pounds.*
June 29	9	29	25
July 5	25	39	36
July 11	33	46½	43
July 21	56	61	56
July 24	64	65	59

In the early stages of growth the yields from the blue and white lupines were larger than from the yellow species. Later in the season, however, the yields were practically the same. White lupines sown the middle of August made a growth of about 2 ft. and a satisfactory yield of green material before frost. Because of their quicker growth, the author recommends the substitution of white and blue lupines for the yellow lupine, which, he states, is the variety most in use in Schleswig-Holstein.

Experiments with lupines in Belgium, P. DE CALUWE (*Exposé Cult. Expér. Jard. Gand, 1892-'93, pp. 24-29*).—Yellow, white, and blue lupines were tested on a sandy soil. White lupines gave the largest yield of organic matter and of grain. The early growth of yellow lupines planted in spring was slow. Blue lupines were much injured by a fungus disease. White lupines planted August 12 made a very satisfactory growth by the middle of November. Experiments with different forms of phosphoric acid were made on lupines.

On the relation of the composition of soils and of oats produced on them, A. ATTERBERG (*Kgl. Landt. Akad. Handl. Tidskr., 33 (1894), pp. 170-190*).—The investigation was undertaken to study the relation between soil and product, and to obtain definite information on the proper methods of fertilization for improving the crop. The paper gives the results of chemical analysis of 96 samples of soil from southern Sweden and the amounts of fertilizing ingredients in oats grown on these soils.

The fertilizing ingredients in the harvested crops are summarized below:

Fertilizing ingredients in oats grown on different soils.

	In grain.		In straw.
	Nitrogen.	Phosphoric acid.	Potash.
	Per cent.	*Per cent.*	*Per cent.*
Average	1.62	0.73	1.52
Maximum	2.53	1.09	2.81
Minimum	1.20	0.37	0.28

The results obtained indicate that 0.07 per cent of phosphoric acid in calcareous, sandy, and clayey soils is sufficient to produce oats of satisfactory phosphoric acid content; 0.13 per cent of phosphoric acid proved sufficient in these soils to produce oats of high phosphoric acid content, and 0.20 per cent always gave crops rich in phosphoric acid.

One tenth per cent of potash seemed a rather low content in the class of soils mentioned for the requirement of oats; 0.11 and 0.12 per cent gave crops containing sometimes a low, sometimes a fair percentage of potash, while 0.20 per cent of potash was an ample amount.

Peaty soils were entirely different in behavior from the mineral soils. Even with considerable quantities of potash and phosphoric acid present in the former, the crops were often poor in these constituents. The results, therefore, indicate that peaty soils, like those used in this investigation, being relatively poor in lime and free from clay, are in general benefited by applications of phosphates and potash.

Humus soils differ from mineral soils in the availability of their phosphoric acid, while their potash shows a similar solubility to that of mineral soils. Even as high as 0.20 per cent phosphoric acid in humus soils does not seem to produce particularly high phosphoric acid contents in oats. Their phosphoric acid seems largely combined with the humus in a somewhat insoluble form, and is rendered available only through lime and alkali.

The humus soils examined contained from 11 to 26.5 per cent of humus; the lime varied from 0.28 to 1.38 per cent. In soils richer in lime it is presumed that the phosphoric acid would be more easily soluble than was the case with these soils.

Points of special interest brought out by the investigation are the parallelism between the phosphoric acid contents in the calcareous soils and in the corresponding crops of oats, and also between the potash of the humus soils and that of their crops. The low potash contents found in numerous sandy soils and in the crops of oats grown on them are further interesting. The same holds true of a number of peaty soils to which potash fertilizers were added, showing the need of increased potassic fertilization on such soils.—F. W. WOLL.

Experiments with oats in 1894, G. E. MORROW and F. D. GARDNER (*Illinois Sta. Bul. 34, pp. 412–417*).—In 1894 the largest yields

were made by Texas Rust Proof, Lincoln, Texas Red, New Dakota Gray, Calgary Gray, and New Red Rust Proof oats. As the average of 5 years Pringle Progress gave the largest yield, followed by Texas Rust Proof, New Dakota Gray, New Red Rust Proof, American Banner, and Improved American.

"The average weight of 100 berries was 2.27 gm., the range being from 1.71 to 2.70 gm. This gives the average number of kernels per bushel approximately as 640,000, the range being from 537,000 to 850,000. . . .

"The average number of stubs on 1 sq. ft. was 44, the range being from 33 to 61.

"In 1894 the kernel averaged 72.1 per cent of the weight of the entire grain, the range being from 66.8 to 76.6 per cent. . . .

"Each of the mixtures of varieties gave a slightly larger yield than the average yield of the varieties used in making the mixtures."

Rolling plats after the seed was sown seemed to be without effect.

Amount of seed oats per acre, T. WINTER (*Bd. Agr. Rpt. Distrib. Grants for Agl. Education in Great Britain 1893-'94, p. 46*).—The author states that in Anglesey it is customary to sow 8 imperial bushels of oats per acre, under the impression that lodging is thus lessened, a view not accepted by the author. On strong land in 1893 Black Tartarian oats were sown at the rate of 2, 4, and 6 bu. per acre. From 2 bu. the yield was 40½ bu., from 4 bu. 49⅘ bu., and from 6 bu. 48 bu. When 6 bu. was used the weight of a bushel of oats was 43 lbs.; when either 2 or 4 bu. was sown the weight per bushel was 40 lbs. On account of a dry summer there was no opportunity to observe the effect of the thickness of seeding on the lodging.

Effect of different phosphates on oats, KLEIN (*Verhandl. Ges. deut. Naturforsche und Aerzte, 1893, II, pp. 124, 125; abs. in Chem. Centbl., 1894, II, No. 10, p. 483*).—To ascertain whether Belgian phosphate meal and bone meal poor in lime had the same effect on the growth of oats as superphosphates, phosphate of potash, and Thomas meal, water cultures with this plant were made, using a solution having in the first stages of the plant's growth a concentration of 1 to 2,000, and later of 1 to 1,000. With the last 3 fertilizers good results were obtained, while the other fertilizers gave unsatisfactory results. Field experiments along the same line substantiated in the main the results of pot experiments.

Transplanting Irish potatoes, C. L. NEWMAN (*Arkansas Sta. Bul. 28, pp. 96-100*).—Potatoes for the second crop were planted the last week in July. A similar lot of seed potatoes was placed in a bed kept constantly moist and thus forced into an early growth. The plants from this bed were transplanted to the field as soon as they attained sufficient size. A small percentage of these plants died. However, there was 95 per cent of a perfect stand on the transplanted plats, and only 60 per cent of a perfect stand on the plat planted in the ordinary manner. The actual yield per acre from planting was 64 bu., from transplanting, 86½ bu. However, when allowance was made for missing hills the estimated yield was greater from planting than from transplanting.

Culture experiments with potatoes, A. RINDELL (*Mustiala Agl. College Rpt. 1892, pp. 18–20*).—The experiments include culture trials with 15 different varieties of potatoes, with determinations of the yields and starch contents of the different varieties, and the yield of starch per hectare in each case. The potatoes grown contained from 12.3 to 20.3 per cent starch, the average being 14.91 per cent.—F. W. WOLL.

Potatoes (*Ontario Agl. Col. and Exptl. Farm Rpt. 1893, pp. 225–230*). Report and discussion of a coöperative test of potatoes undertaken by several members of the Ontario Agricultural and Experimental Union. The selection of perfect, average-sized potatoes is advised, and storing in pits during the winter. Rural No. 2 gave the highest yields, followed by Empire State. Kaiser, a new variety, is recommended. The results are detailed in 2 tables.

Experiments with potatoes and root crops in Belgium, P. DE CALUWE (*Exposé Cult. Expér. Jard. Gand, 1892–'93, pp. 36–42, 45, 46, 59, 60, 63–73*).—These experiments consisted of variety, fertilizer, and culture experiments on potatoes; fertilizer experiments on chicory and parsnip; effect of treating potatoes with Bordeaux mixture; and variety tests of beets and turnips. When potatoes were cut into sections and the cut surface placed downward, the crop was in two instances larger and in two instances smaller than when the cut surface was uppermost. On chicory in a dry year there was but little difference in the crop whether organic, nitric, or ammoniacal nitrogen was used. On parsnips nitric nitrogen gave the best results. Potash was more effective on parsnips than on chicory.

Analyses of root crops, A. E. SHUTTLEWORTH (*Ontario Agl. Col. and Exptl. Farm Rpt. 1893, pp. 36–40*).—Analyses of 4 varieties of mangel-wurzels, 5 of Swedish turnips, and 6 of fall turnips, and the average analyses and the yield of roots grown at different distances.

Average weight and yield of roots grown at different distances.

	Dry matter.	Average weight per root.	Yield per acre.	Dry matter per acre.
	Per cent.	*Pounds.*	*Tons.*	*Pounds.*
Mangels:				
Unthinned	21.93	0.16	15.45	6,776
8 in	13.24	1.34	19.32	5,116
20 in	9.23	1.36	15.01	2,771
Swedes:				
Unthinned	16.10	0.20	7.65	2,463
8 in	12.12	1.60	20.54	4,979
20 in	11.64	2.44	14.00	3,259
Fall turnips:				
4 in	8.93	1.02	19.61	3,502
12 in	8.92	1.59	17.57	3,134
20 in	7.84	2.97	13.19	2,068

"[The table] shows a greater variation in the composition of the same variety than was observed in different varieties.

"(1) Variation in distance between the plants influences the size, the yield, and the composition of the roots.

"(2) There is a regular decrease in the per cent of dry matter with an increase in the distance between the plants.

"(3) There is a regular increase in the average size of the roots with an increase in the distance between the plants.

"(4) It appears from conclusions 2 and 3 that conditions increasing the average size of roots increase their per cent of water.

"(5) Yield increases with an increase in distance between plants in the drill to a certain distance, which appears to be between 8 and 12 in., and beyond this it decreases.

"(6) More dry matter is produced by thinning to a distance of 8 than 20 in.

"(7) Roots tending to lengthen rather than broaden should be thinned to a distance of 8 or 9 in. apart in the drill, otherwise the distance should be about 10 in."

Experiments with rye, C. L. NEWMAN (*Arkansas Sta. Bul. 28, pp. 90–93*).—Rye planted in November in drills 18 in. apart, on heavily manured soil, was cut 3 times, and gave a total yield of 43,516 lbs. of green forage per acre. The heaviest cutting, made April 28, yielded 26,460 lbs. of green forage which when cured made 9,261 lbs. of hay. This hay contained 8.31 per cent of protein, and had a nutritive ratio of 1:10, while hay made from rye cut several weeks earlier "when in boot" contained 13.25 per cent of protein with a nutritive ratio of 1:5.2.

The yield of green rye per acre on plats on which pea vines were turned under a few days before the rye was planted averaged 6,497 lbs. per acre. On plats similarly fertilized, but without green manuring, the yield was 3,715 lbs. of green rye per acre. Nitrate of soda, muriate of potash, acid phosphate, and all three combined were more effective when used on rye following peavines than when applied to rye which had not been preceded by a green manuring crop.

Sugar beets, N. E. WILSON (*Nevada Sta. Bul. 23, pp. 36*).—Tabulated data giving composition of samples of beets analyzed in 1891, 1892, and 1893; notes on the culture of beets; extensive quotations dealing with the work done at Schuyler, Nebraska, by the Division of Chemistry of this Department; and statistics relative to the yield and consumption of sugar in the United States, and the cost of manufacturing sugar in this country and in Europe. At the station all samples of beets analyzed in 1891 averaged 13.20 per cent sucrose with a purity of 76.87; those grown in 1892 averaged 15.56 per cent sucrose and 80.76 purity; those grown in 1893, 14.23 per cent sucrose and 80.76 purity. The experiments for 1893 here reported closed the work of the station in this special line.

Varieties of sugar cane grown in Antigua in 1893, F. WATTS (*Suppl. Leeward Islands Gaz., 1894, June 21*).—Of 14 varieties of sugar cane grown on well-tilled calcareous soil Rappoe gave the largest yield per acre of cane sugar in the juice, namely, 4,907 lbs. Of 16 varieties grown on stiff non-calcareous soil Keni Keni gave the largest yield of cane sugar in the juice, 4,593 lbs. Analyses of the canes and of their juices are given.

Hairy vetch for green manuring, L. SCHIRMER (*Sächs. landw. Ztschr., 1894, Aug. 11; abs. in Jour. Agr. Prat., 58 (1894), No. 34, pp. 265, 266*).—The author conducted experiments near Magdeburg, Germany, for several years to determine the relative value as a green manure of hairy vetch, white lupines, blue lupines, yellow lupines, flat pea, and serradella. The plants were sown under two different conditions, (1) in the spring in a growing grain crop, and (2) immediately after the grain harvest. Late in the season the green growth was plowed under and potatoes planted the following year. The amount of nitrogen contained in the leguminous crops per acre ranged between 44½ and 89 lbs., depending upon the plant employed. The vetch afforded the largest amount of nitrogen and gave the largest yield of potatoes in the following year. The potato crop following yellow lupines was smallest.

When it is desired to save seed of hairy vetch the author recommends sowing a mixture of ¼ vetch and ¾ rye; when forage is desired the proportion is reversed.

Field experiments with wheat, G. E. MORROW and F. D. GARDNER (*Illinois Sta. Bul. 34, pp. 402–411*).—A test of varieties, of mixtures of varieties, and of the thickness of sowing. Of 60 varieties tested, the largest yields in 1894 were made by New Michigan Amber, Yellow Gypsy, Crate, Rock Velvet, Royal Australian, Currell Prolific, Diehl Mediterranean, and Missouri Blue Stem.

"Thirty-seven plats of bearded wheat averaged 35, and 30 plats of smooth averaged 36.8 bu. Thirteen plats of wheat classed as white averaged 34.7, and 56 classed as brown or red averaged 35.8 bu. . . . The average number of stubs on 1 sq. ft. was 51, the range being from 34 to 65. . . . The average weight of 100 kernels of wheat in 1894 was 3.35 gm., the range being from 2.40 to 4.04. . . . The average number of kernels per bushel of the wheat grown at this station this year was a little over 800,000, the extremes being about 600,000 and 1,130,000. . . .

"In 1892 the yields of each of 4 plats sown with a mixture of several varieties was somewhat greater than the average of the varieties composing this mixture. Seed from these mixtures was sown in fall of 1893. In but one case was the yield greater than the average yield of all the plats, and in but one was it greater than that of the plats adjoining."

Tabulated data give the percentage of germination, the date of ripening and harvesting, length of straw, character of the plant, number of stubs per square foot, weight of 100 kernels, weight per bushel, and the yield of straw and grain per acre. The yields of varieties grown for a number of years at the Indiana, Ohio, and Pennsylvania Stations, as well as the Illinois Station, are given. In a list of 25 varieties, each of which had been tested 7 or more times, the following gave the largest average yields for the 4 stations: Poole, Valley, Royal Australian, Red Tasmanian, and Nigger.

Wheat at the rate of 3, 4, 6, 7, 8, and 9 pecks of seed per acre was sown. The largest yield in 1894 resulted from the use of 4 pecks of seed. For the preceding 5 years the average results were slightly in favor of sowing 8 pecks per acre.

Field experiments with wheat, W. C. LATTA (*Indiana Sta. Bul. 51, pp. 59–77*).

Synopsis.—The experiments are classed under the following heads: (1) Test of varieties, (2) quantity of seed per acre, (3) early and late sowing, (4) rotation *vs.* continuous grain cropping, (5) early and late harvesting, (6) experiments with commercial fertilizers and manure, and (7) coöperative experiments with varieties. The results in 1894 differed in most instances from the average of preceding years. The largest yields were made by the variety Rudy; by sowing 6 pecks of seed; by sowing October 4; and by harvesting late. Stable manure in all cases yielded a profit. Commercial fertilizers gave a profit in all cases when used on wheat grown in rotation, but failed to give a net profit when used on wheat grown continuously on the same plats.

These experiments, conducted in 1894, are in continuation of those recorded in Bulletin 45 of the station (E. S. R., 5, p. 185).

Test of varieties (pp. 59–63).—Tabulated data and descriptive notes are given for 37 varieties of wheat tested in 1894, and the average yields of varieties tested for 2 to 11 years. In 1894 the largest yield, 45.75 bu. per acre, was made by Rudy. Other varieties yielding more than 40 bu. per acre were Fulcaster, Harvest Queen, Jones Winter Fife, Wyandotte, American Bronze, Reliable Minnesota, Early Genesee Giant, and Brown Bearded Velvet Chaff. By comparing the yields of varieties grown at the station 11 years without change of seed, with varieties brought to the station in recent years, the writer finds evidence that varieties of wheat do not "run out" when selection of seed and careful culture are practiced.

Quantity of seed per acre (p. 64).—In 1894 wheat at the rate of 2 to 10 pecks per acre was sown. The largest yield resulted from 6 pecks of seed. Taking the averages for 9 years every increase in the quantity of seed up to 8 pecks was followed by an increase in the resulting crop.

Early and late sowing (pp. 64, 65).—In 1894 seed sown October 4 gave a larger yield than earlier or later sowing. In former years earlier sowing had given better results than late sowing.

Rotation vs. continuous grain cropping (pp. 65, 66).—In 1894 the yield of wheat on the plats where the rotation of grain and grass was practiced was 9.93 bu. greater than on the plats on which grain was grown continuously. This increase was greater in 1894 than the average increase of the preceding 7 years.

Early vs. late harvesting (pp. 66, 67).—In 1894 the first cutting was made June 19, at which time most of the wheat was in the milk stage. When the harvesting was very early the yield was 25.6 bu., early 30.5, medium 34.3, late 35.8, very late 33.5. The wheat ripened in 1894 more satisfactorily than in preceding years. "It would appear, therefore, from the results obtained this year, that the harvest should begin when the wheat is fully in the dough, and be completed by the time the wheat is fully ripe."

Experiments with commercial fertilizers and manure (pp. 67–71).—On wheat alternating with corn, clover being grown as an intercrop and

occupying the land during the winter, commercial fertilizers and stable manure, whether used in large or small quantities, yielded a profit, with wheat at 50 cts. per bushel and straw at $3 per ton. On wheat grown in rotation with corn and oats, rye being the intercrop after corn and clover after wheat, commercial fertilizers gave practically no net profit, while stable manure at the rate of 2 tons per acre yielded a profit of $2.21 per acre; at the rate of 3 tons, a profit of $3.13.

Coöperative experiments with varieties (pp. 71–77).—These experiments were conducted in Tippecanoe, Jefferson, Madison, Whitley, and Dekalb counties. Of 4 varieties tested the best average yield, 36.58 bu. per acre for all the counties, was made by Jones Fife.

Experiments with winter wheat, C. A. ZAVITZ (*Ontario Agl. Col. Bul. 97, pp. 15*).—To determine the loss from the lodging of grain 1,000 heads of grain which were partly lodged about 5 weeks before the ripening season were compared with 1,000 heads of standing grain. The results showed a loss of about 45 per cent in weight and of 11 per cent in quality due to lodging.

In variety tests continued for 5 years the following varieties made large yields: Dawson Golden Chaff, American Bronze, Early Genesee Giant, Surprise, Early Red Clawson, Golden Drop, Jones Winter Fife, Bulgarian, Early Ripe, and Pride of Genesee. Dawson Golden Chaff made the best record of all varieties of winter wheat tested. For 5 successive years the bearded wheats gave a larger average weight per bushel than the smooth varieties. Varieties with white grain yielded more than those with red grain in favorable years, but less in unfavorable years. Wheat sown September 9 gave a larger yield than that sown September 2 and 17. Drilling wheat gave a larger yield than broadcasting, and 2 bu. of seed produced a larger crop than either 1 or 1½ bu.

Specific gravity and weight of wheat seeds, L. H. PAMMEL and F. C. STEWART (*Iowa Sta. Bul. 25, pp. 26–31*).—Thirty-seven samples of wheat were examined. The number of kernels per gram, pound, and bushel, and the specific gravity of seeds, are tabulated. The number of kernels of wheat per bushel ranged between 489,879 and 1,184,693, the average being 770,200. The specific gravity of wheat seeds varied between 1.407 and 1.503, with an average of 1.469. The specific gravity of Stowell Evergreen corn was found to be 1.53, of white clover seed 1.41, of kale seed 1.35, and of ruta-baga seed 1.38.

Forms of nitrogen for wheat, H. A. HUSTON (*Indiana Sta. Bul. 51, pp. 78–80*).—This is in continuation of an experiment recorded in Bulletin 45 of the station (E. S. R., 5, p. 186). On account of injuries from rust no conclusions are drawn from the tabulated data giving the yields of wheat fertilized with different forms of nitrogen applied at different seasons.

Report of agriculturist, W. C. LATTA (*Indiana Sta. Rpt. 1893, pp. 25–31*).—Unfavorable meteorological conditions in 1893 greatly interfered with the field experiments, the results of which are reported

in brief. The experiments consisted of variety tests of wheat, corn, and oats; amount of seed for wheat, corn, and oats; dates for planting corn and wheat; deep and shallow plowing and deep and shallow cultivation for corn; experiments with different corn cultivators; fertilizer experiments; experiments comparing rotative with continuous cropping; a test to determine the effect of spring mowing of wheat; improvement of corn by selection and care; and relation of early and late planting of corn to length of time required to mature the crop. Most of these experiments were in continuation of those of previous years. By mowing wheat in the spring the yield was reduced by 5.02 bu. per acre. The following table gives the results of an experiment conducted in 1892 and 1893 to determine the length of the growing period of corn planted at different dates:

Length of growing period of corn planted at different dates.

	1892.	1893.	Days to mature—average 2 years.
Planted		May 6	122
Do		May 16	117
Do	May 24	May 27	112
Do	June 4	June 6	109
Do	June 14	June 16	107

Report of the botanist, J. FLETCHER (*Canada Exptl. Farms Rpt. 1893, pp. 188–193, figs. 3*).—*Report on the arboretum.*—Brief notes are given on some of the additions made to the arboretum during the past year. The collection at present consists of 600 species and varieties of trees and shrubs representing 37 genera. Notes have been taken as to their period of flowering, hardiness, and general desirability for extended use.

Awnless brome grass.—This grass, *Bromus inermis*, also known as Austrian or Hungarian brome grass, has been cultivated in Ottawa for 6 years and has gained in favor wherever tried. It is considered the best of the introduced grasses in respect to feeding value, hardiness, earliness, habit of growth, and aftermath.

Grass for the protection of shores and harbors.—The frequent requests regarding the use of grass for the protection of shores led the author to investigate the desirability of several species in this respect. *Psamma arenaria* (*Ammophila arundinacea*), or beach grass, proved the best suited to this use, with *Elymus arenarius*, sand lyme grass, next.

Tumbleweeds.—Brief notes are given on the tumble mustard (*Sysimbrium sinapistrum*) and the Russian thistle (*Salsola kali tragus*). Attention is called to these two weeds and farmers are warned against letting them gain a foothold. Both seed abundantly and are difficult to eradicate when once established.

Experiments with field crops in Ontario, C. A. ZAVITZ (*Ontario Agl. Col. and Exptl. Farm Rpt. 1893, pp. 57–110*).—In the variety tests there were grown 73 varieties of barley, 81 of peas, 73 of spring

wheat, 52 of winter wheat, 133 of oats, 21 of beans (including 6 varieties of soja beans), 3 of buckwheat, 157 of potatoes, 54 of Swede turnips, 37 of flat turnips, 49 of mangel-wurzels, 34 of carrots, 10 of sugar beets, 93 of fodder corn, 12 of millet, 11 of rape, and 2 of sunflowers.

Taking the average results for 5 years, Mansury barley (from Russia) gave the largest yield of all varieties. Of the varieties of peas tested for 3 years Early Briton and Prussian Blue gave the largest average yields of grain. Herison Bearded gave the largest average yield of the varieties of spring wheat tested for 5 years, and Red Fern the largest for those tested 4 years. Of the varieties of winter wheat tested for 5 years, Surprise and Early Red Clawson were most productive; of those tested 3 years, American Bronze and Egyptian; of those tested 2 years, Dawson Golden Chaff and Mediterranean.

Joanette Black, Chenailles Black, and Black Etampes gave the largest average yield of the varieties of oats tested for 5 years. Siberian occupied fourth place, and is highly commended.

Large seed of barley, peas, and spring wheat gave heavier yields of grain than small seed.

Of 157 varieties of potatoes grown in 1893 Empire State gave the largest yield. For 3 years seed potatoes were planted at depths of 1, 3, 5, and 7 in. The average yields increased with the depth of planting.

Experiments to determine the best distance, size of cutting, and fertilizers for potatoes were conducted; also distance experiments for Swede turnips, fall turnips, mangel-wurzels, carrots, and fodder corn. In the distance experiment with fodder corn an early, a medium, and a late variety were used. With all of these the largest yield of forage was secured by planting in drills 30 in. apart and thinning to 4 in. in the drill. With Swede turnips flat and ridge cultivation gave practically the same results.

Various mixtures of peas and vetches with small grains were sown for forage. Rape grown under favorable conditions yielded at the rate of 27.7 tons of green forage per acre.

Field experiments in Manitoba, S. A. BEDFORD (*Canada Exptl. Farms Rpt. 1893, pp. 229–253*).—At the experimental farm at Brandon a large part of the work for 1893 consisted of variety tests with wheat, oats, barley, peas, fodder corn, millet, turnips, mangel-wurzels, sugar beets, carrots, and potatoes, and experiments to determine the best time for sowing wheat, oats, and barley.

Wheat was harvested in the early milk, late milk, dough, and ripe stages. When harvested in the early milk or late milk stage the yield was considerably less than when allowed to reach the dough state. There was but little difference in the yield resulting from harvesting in the dough state and when "ripe yellow."

Taking the average for 4 years, wheat sown with a common drill yielded 30 bu. 44 lbs. per acre, with a press drill 30 bu. 29 lbs., broadcast 25 bu. 18 lbs., showing a loss of about 5 bu. per acre from sowing

broadcast. With barley the loss from broadcasting, compared with the results obtained from the use of the press drill, was 11 bu. 8 lbs. per acre. For barley the press drill gave better results than the common drill.

Of the 45 varieties of oats tested in 1893 Banner gave the largest yield, 91 bu. 6 lbs. per acre. Of the varieties of barley tested for 4 years the largest yields were made by Duckbill, Goldthorpe, and Odessa.

Mixtures of small grain and peas were grown, and after threshing the mixture it was found that the peas represented a very small proportion of the grain produced, even when sown in larger quantity than the small grain. Peas sown at the rate of 3 bu. per acre gave a larger yield than when the rate was 2 or 4 bu. per acre.

Experiments were conducted with methods of destroying the troublesome weeds *Agropyrum glaucum* and *Hierochloa borealis*.

Sunflowers produced seed at the rate of 35 bu. per acre. The yield of hay made by 6 species of grasses was determined.

Field experiments in the Northwest Territories (**Canada**), A. MacKay (*Canada Exptl. Farms Rpt. 1893, pp. 273–292*).—Among the experiments conducted in 1893 at the experiment farm at Indian Head were the following: Variety tests of wheat, barley, oats, peas, corn, turnips, mangel-wurzels, sugar beets, and potatoes, and experiments to determine the best dates for sowing wheat, barley, and oats.

Red Fife wheat planted 2 in. deep May 4 gave a larger yield of grain than when planted 2½ in. deep. For wheat the press drill gave better results than the common drill. The best preparation for wheat was found to be a summer fallow; spring plowing gave much better results than fall plowing. With barley the use of the press drill resulted in a yield greater by 7 bu. per acre than that obtained by the use of the common drill and greater by 9 bu. 28 lbs. than that obtained by sowing broadcast. Barley preceded by summer fallow yielded 48 bu. 10 lbs.; when the preparation consisted of fall plowing of stubble the yield was only 41 bu. 32 lbs. The use of 2 bu. of barley per acre as seed gave a larger yield than 1¾ bu. or 1½ bu.

For oats summer fallow proved the best preparation; spring plowing 3 in. deep gave a larger yield than fall plowing 6 in. deep. Oats planted with a press drill yielded 100 bu. per acre, with a common drill 85 bu. 30 lbs., and broadcast 75 bu. 20 lbs. A larger yield resulted from planting oats 3 in. deep than from planting at a depth of 2 in.; 2 bu. of seed per acre gave larger yields than 2½ and 2¾ bu.

Of 16 grasses sown only 2 produced a crop, 1 of which was *Bromus inermis*. This grass was 6 in. high before a green blade could be seen on the prairie, and it proved hardy in severe winter weather.

Experiments with field crops in British Columbia, T. A. Sharpe (*Canada Exptl. Farms Rpt. 1893, pp. 315–337*).—Among the most important experiments made at the experiment farm at Agassiz in 1893

were experiments with fall wheat, spring wheat, barley, oats, cross-bred wheats, peas, corn, turnips, mangel-wurzels, carrots, sugar beets, and potatoes, and dates for seeding spring wheat, barley, and oats.

The flat pea (*Lathyrus sylvestris*) was grown. "Neither our cattle nor horses care for it. They were led to the plat during June and July, but in no case would they eat it, preferring the green grasses growing alongside." Millet, hemp, jute, and peanuts failed to mature. Sunflowers harvested October 16 and 17 yielded at the rate of over 8 tons of heads per acre.

Experiments with farm crops in Nova Scotia, W. M. BLAIR (*Canada Exptl. Farms Rpt. 1893, pp. 213–225*).—Among the experiments conducted were variety tests of spring wheat, barley, oats, peas, turnips, mangel-wurzels, carrots, sugar beets, corn, potatoes, broom corn, and beans, and experiments to determine the best date for sowing wheat, barley, and oats.

Experiments with small grain at Ghent, Belgium, P. DE CALUWE (*Exposé Cult. Expér. Jard. Gand, 1892–'93, pp. 8–22*).—Fertilizer experiments and variety tests of rye, wheat, barley, and oats were conducted. Dattel wheat grown on sandy soil of the station and then for 2 years on a better wheat soil in a different locality was compared with the same variety grown continuously for 4 years at the station, but no advantage was found to result from the change of seed. Analyses of winter and spring barley are given.

Culture of alfalfa, V. AUBERT (*Bul. Jour. Soc. Central d'Agr., Alpes-Maritimes, 34 (1894), No. 9, pp. 165–171*).—A popular article on the best soil, preparation, and manuring for this crop.

Composition of beets and beet leaves, HERZFELD (*Ztschr. Zuckerind, 44 (1894), p. 641; abs. in Chem. Ztg., 18 (1894), No. 78, Repert., p. 236*).

Removing tassels from corn, G. C. WATSON (*New York Cornell Sta. Rpt. 1892, pp. 143–155*).—A reprint of Bulletin 40 of the station (E. S. R., 4, p. 338).

Marram grass, S. T. AVERY (*Gard. Chron., ser. 3, 16 (1894), p. 533*).—Description of this Australian grass, *Ammophila arenaria*, valuable on very loose sand.

Physiological studies on hops, J. BEHRENS (*Abs. in Bot. Centbl., 60 (1894), No. 6, pp. 178–180*).

The manuring of meadows and pastures, L. GRANDEAU (*Jour. Agr. Prat., 58 (1894), No. 44, pp. 631, 632*).

The yield and malting value of 8 varieties of barley, M. J. R. DUNSTAN (*Rpt. Expts. in Agr., 1893, Notts Co., England, pp. 3–14, 18–19*).

Fertilizer experiments on meadows, M. J. R. DUNSTAN (*Rpt. Expts. in Agr., 1893, Notts Co., England, pp. 14–18*).

Effect of cutting seed potatoes, A. GIRARD (*Jour. Agr. Prat., 58 (1894), No. 44, pp. 635–640*).—A record of certain experiments in France.

Methods of storing potatoes, G. HÜNERSDORF (*Deut. landw. Presse, 21 (1894), No. 78, p. 744*).—Popular.

The flowering of sugar cane in its relation to degeneration, J. H. WAKKER (*East Java Expt. Sta. Bul. 11, n. ser., pp. 10, pl. 1*).

The culture of tobacco in Hessen (*Ztschr. landw. Ver. Hessen, 1894, No. 23, pp. 186, 187*).

Analyses of Tumut tobacco, F. B. GUTHRIE (*Agl. Gaz. N. S. Wales, 5 (1894), No. 9, pp. 663–666*).—Analyses with special reference to soil exhaustion.

Growing of white vetches, N. J. ACOSTA (*Bol. Nac. Agr., 18 (1894), No. 15 and 16, pp. 382–384*).

Hairy vetch, J. BIZE (*Chron. Agr., 7 (1894), No. 19, pp. 487–493*).—Popular.

Variety tests of wheat, oats, barley, and potatoes, F. WOHLTMANN (*Deut. landw. Presse, 21 (1894), No. 78, pp. 740, 741*).—Notes on varieties growing on an estate in Schleswig.

Experiments with different forms of phosphates and of nitrogen on wheat and potatoes, GRANDEAU (*Sem. Agricol., 14 (1894), No. 701*).

The advantage of drilling grain over sowing broadcast in dry seasons, E. ZOLLIKOFER (*Landw. Wochenbl. Schles. Holst., 1894, No. 25, pp. 383, 384*).—Observations on the growth of drilled and broadcast barley.

Loss of weight in storage of cereals (*Tidskr. Landtmän, 15 (1894), pp. 651–653*).

Quality of seed of small grains, leguminous plants, and grasses, as affecting the yield, R. SCHMOLD (*Fühling's landw. Ztg., 43 (1894), No. 15, pp. 466–475*).—Experiments to determine influence of size of seed, stage of ripeness, age, and sprouting on germination and yield.

Coöperative experiments with field crops, C. A. ZAVITZ (*Ontario Agl. Col. and Exptl. Farm Rpt. 1893, pp. 246–269*).—Seeds and fertilizers were sent to 1,200 experimenters in Ontario, and from the reports received 416 were selected and their results published. These experiments consisted of tests of fertilizers on oats and rape; variety tests of millet, corn, turnips, mangel-wurzels, carrots, spring wheat, winter wheat, barley, and peas; and an experiment in cultivating alfalfa.

Crops and live stock in Ontario (*Ontario Bureau Industries Bul. 51, pp. 8*).—A report on the weather and on the condition of farm crops, fruit, pastures and live stock, bees and honey, farm labor and wages, and area and yield of field crops.

Southern Branch Arkansas Experiment Station, R. L. BENNETT (*Arkansas Sta. Bul. 28, pp. 87–89*).—Notes on the character of the soil and on the work done at the substation at Camden in 1893.

HORTICULTURE.

Protection of fruits, vegetables, and other food products from injury by heat or cold during transportation, M. W. HARRINGTON (*U. S. Dept. Agr., Weather Bureau Circular, 1894, Aug. 22, pp. 7*).—This circular contains general remarks on the temperatures at which various perishable goods can be shipped without spoiling, a more or less detailed recounting of the methods employed by shippers to protect articles from damage by freezing and by heat, and observations on the relation between the temperature of the air without and within ordinary freight cars and cars especially adapted to the transportation of perishable goods. The difference was found to be from 5 to 15° F. A table is given showing the lowest and highest temperatures to which various perishable goods may be subjected without injury.

Onions from seed, C. L. NEWMAN (*Arkansas Sta. Bul. 28, pp. 93–95*).—The seeds of 9 varieties of onions were planted in drills in 2½ ft. rows fertilized with cotton-seed meal and kainit. In order to test the effect of transplanting, when the plants were about one eighth in. in diameter they were thinned to 4 in. in the drill, and the removed

plants transplanted 4 in. apart in other rows. Both seedlings and transplanted plants were given plow cultivation. A table is given showing the yields per acre of each variety, by which it is seen that in nearly every case the transplanted plants yielded about 15 per cent more marketable onions than those not transplanted. Early Red Globe produced the largest crop.

Hints on the planting of orchards, L. H. BAILEY (*New York Cornell Sta. Bul. 69, pp. 242–254*).—General directions for the establishing and care of orchards, treating of the preparation of the land, selection of the trees, time and method of planting, distance of trees apart, trimming and pruning, and after cultivation.

It is advised that the land be evenly drained and in good tilth, free from hard places and weeds. Planting in August or September is preferred to spring planting, even for peaches. A table is given showing the proper distances apart that various orchard and small fruits should be planted. The method of setting out the trees is detailed, urging the spreading out of the roots in large holes with loose earth in the bottom, and cautioning against fall mulches as harboring mice. It is suggested that peach trees be trimmed close, with spurs of 1 bud only left on the stem, but that other fruits be left 4 or 5 of the best branches with a few buds each. Thorough cultivation is recommended for at least 2 years, and careful watching against insect attacks.

The various points are stated concisely and clearly, with the intention of furnishing definite information on the subject to those beginning fruit raising.

Apricot growing in western New York, L. H. BAILEY (*New York Cornell Sta. Bul. 71, pp. 271–292, figs. 11*).—This bulletin treats of the cultivation of the apricot and of the different varieties of the 3 species of true apricots in cultivation in western New York. It is stated that the apricot is as hardy as the peach and worthy of much more extended cultivation than it now receives. A deep, dry soil, loamy or gravelly, on elevated land near a large body of water, is recommended for the best results, and if possible a somewhat backward exposure to retard early blooming. The apricot requires clean culture, which should, however, be stopped late in summer to allow the wood to mature thoroughly. Pruning should be done much the same as for plums. Apricots are usually grafted upon peach, plum, or apricot stocks, but do not seem to unite well with the two former stocks, and so where seedling apricots will grow well they are to be preferred as stocks. In stiff clay lands plum stocks may thrive better, and in light dry soils, peach stocks. The apricot is considered practically as productive as the peach, and is attacked by the same insect and fungus enemies. In addition to cultivating apricots in orchards they may be trained against walls and buildings, and thus protected develop fruit in otherwise unfavorable localities.

The 3 species of apricots in cultivation are the purple (*Prunus dasycarpa*), the Chinese or Japanese (*P. mume*), and the common and Russian apricots (*P. armeniaca*). The purple apricot is considered of little merit and is a round, plum-like dark red fruit, stalked and fuzzy, with soft, subacid flesh, clinging tightly to the pit. The Chinese or Japanese apricot is also of little value, with small, hard clingstone fruits, but possessing fragrant flowers that are often double and ornamental. The Russian apricots are smaller and poorer than the ordinary standard sorts. Several varieties of apricots are described and figured, and the following are recommended for planting: Smith Early, Harris, Early Moorpark, St. Ambroise, Turkish (probably Roman), Montgamet, Royal, and Moorpark.

The native dwarf cherries, L. H. BAILEY (*New York Cornell Sta. Bul. 70, pp. 259–265, figs. 5*).—This bulletin comprises the results of investigations upon dwarf or sand cherries made subsequent to the issuing of Bulletin 38 of the station (E. S. R., 4, p. 165). They were studied with a view to utilizing them for the redemption of sandy tracts where it is thought their growth will tend to hold the sand and check its drifting, and for the improvement of other waste lands. Illustrated descriptive notes are given on the sand cherry (*Prunus pumila*), the western dwarf cherry (*P. besseyi*), and the Utah hybrid cherry (*P. besseyi* x *P. watsoni*). They are low-spreading shrubs, rarely more than 4 or 5 ft. high, and bearing thick clusters of small, dark fruit of varying flavor and quality, ripening in July and August. Several of the wild plants bear fruit that is edible, with juicy, aromatic though somewhat astringent pulp, and showing a tendency to improve upon cultivation. Crosses of the dwarf cherries with some of the native plums are giving promising results.

P. pumila, the common sand cherry, is found more abundantly in the region of the Great Lakes and along rivers and lakes in the Northeastern States. The fruit is about ½ in. in diameter and usually nearly black, and sour. *P. besseyi*, which is described as a new species, grows on the plains beyond the Mississippi and on the mountains of Colorado and Utah. Its fruit is nearly twice the size of that of the last, with flavor usually aromatic but sometimes inclined to be bitter or astringent. It is believed to be worthy of efforts toward its improvement. The Utah hybrid cherry is found in Nebraska and westward and possesses a dark brown fruit of about the size of the last, and juicy but of poor quality, with a bitter skin.

Propagating cherries, J. CRAIG (*Canada Exptl. Farms Rpt. 1893, pp. 117, 118*).—Scions of a number of varieties of Morello cherries were grafted on some of the common commercial stocks. Those root grafted gave very poor results, but the crown grafts were correspondingly successful. The bird cherry (*Prunus pennsylvanica*) was used as a stock for budding, but on account of the large amount of sap in the stock the buds did not unite well.

Observations on the germination of buds on the grapevine, V. VANNUCCINI (*Atti. R. Acad. Economico-agraria Firenze, 72 (1894), pp. 82–93*).—From the results of pot experiments on cuttings and grafts of the grape the author concludes that the temperature and moisture content of the soil, as well as the temperature of the air, have their influence in starting the bud. When it is desired to keep cuttings for a long time without starting the buds into growth he recommends the avoidance of water or wet soil, and advises that they be placed in soil but slightly moistened.

The author investigated the cause of the earliness of growth of buds on the upper part of a shoot as compared with those on the lower portion. To show that this was not due to differences in the temperature of the strata of air in which the buds at different heights on the stem were located, he cited the results of experiments in which the buds on the extremity were the first to germinate when the shoots were trained horizontally or even inverted.

Three lots of shoots were cut from grapevines, and after dividing these into equal lengths, thus giving top, middle, and bottom cuttings, all were placed in vessels with their lower portions in water. Those from the top were the first to start buds, but the shoots made by the middle sections were more vigorous. Many of the buds on the bottom cuttings did not develop at all.

Certain buds were coated with gum lac before growth began. This coating greatly retarded their opening. The later opening of the buds on the lower part of the shoots is attributed to the greater degree of lignification in that region and to the greater resistance thus offered to the swelling of the buds. He found the growth from the buds on the middle of the shoot more vigorous than from those at the base. This he attributed to the slight development and premature fall of the leaves, in the axes of which the lower buds are situated, together with the greater resistance to swelling encountered by the buds in this position.

From experiments and observations the author concludes that pruning has no influence in retarding the opening of the buds unless it is practiced before the fall of the leaves in autumn or after the sap has begun to circulate in the spring. When bleeding occurred he found that generally the buds remained dormant until the wound healed and the discharge ceases. He cites an experiment made by Müntz in which on vines pruned September 15 the buds had just germinated March 27 following, at which date there were shoots 1.2 to 3.2 in. long on vines pruned in January. This retarding influence of pruning practiced before the fall of the leaves he attributes to the failure of the wood so treated to store up a normal amount of reserve nutrients.

Vine training, J. CRAIG (*Canada Exptl. Farms Rpt. 1893, pp. 110–112*).—The results of an experiment carried on for 3 years to test the

yield of grapevines trained to single stakes and grown on the European renewal system as compared with that of vines trained to trellises. Ten varieties were employed in the test, and a table is given showing the details of the experiment. The advantage appeared to be in favor of the trellis system, on account of its allowing the vines to be more open and so better utilize the summer heat for the ripening of the grapes.

The effect of summer pruning was tried on some of the stake-trained vines, which gave much more evenly ripened crops than did unpruned vines.

Fruits, S. A. BEDFORD (*Canada Exptl. Farms Rpt. 1893, pp. 257–261*).—Notes on apples, crab apples, plums, cherries, currants, gooseberries, raspberries, and blackberries grown at the Manitoba Experimental Farm. The apple trees were planted in 1889 in 2 lots, one on a hill facing south and the other on lower land with a northern exposure. The first orchard is but slightly protected by snow during the winter, and in consequence the trees suffer considerably. The trees facing north are protected by from 5 to 10 ft. of snow every winter and endure but trifling loss. The blackberries were nearly all killed, and the majorities of the varieties of other fruits tested proved too tender for the climate.

Experiments with cauliflowers, J. CRAIG (*Canada Exptl. Farms Rpt. 1893, pp. 118, 119*).—Notes and tabulated data on 28 varieties of cauliflowers, Gilt Edge, Snowball, Giant White Pearl, and Early Snowball giving most satisfaction among the early varieties, and Large Algiers, Autumn Giant, and Giant Purple Early among the late.

Report on ginger crops in Jamaica, W. FAWCETT (*Abs. in Amer. Jour. Pharm., 24 (1894), No. 12, pp. 593–596*).

Onion cultivation in Egypt (*Bul. Bot. Dept. Jamaica, 1 (1894), No. 8 and 9, pp. 131–133*).—Notes on the cultural methods employed.

Peppermint culture, J. J. WILLIS (*Gard. Chron., 16 (1894), No. 412, p. 594*).—Brief mention of the industry, with notes on the cultivation and statistics of the yield and recommendations for its extended culture, which is shown to be not difficult.

Salsify, C. L. NEWMAN (*Arkansas Sta. Bul. 28, pp. 95, 96*).—Notes on the growing of salsify and directions for its cultivation. Transplanted plants produced a yield about 12 per cent larger than those not transplanted. Recipes for cooking salsify are included, and its more extended culture recommended.

Tomatoes, L. H. BAILEY and L. C. CORBETT (*New York Cornell Sta. Rpt. 1892, pp. 257–301, figs. 4*).—A reprint of Bulletin 45 of the station (E. S. R., 4, p. 547).

Some troubles of winter tomatoes, L. H. BAILEY (*New York Cornell Sta. Rpt. 1892, pp. 213–224*).—A reprint of Bulletin 43 of the station (E. S. R., 4, p. 352).

The cultivation of vegetables, W. HARRIS (*Bul. Bot. Dept. Jamaica, 1 (1894), No. 7, pp. 112–115*).—Remarks on the scanty cultivation of most garden vegetables in St. Andrew, West Indies, and recommendations for their more general growing, with directions for the culture of several of the more important kinds.

Vegetables, S. A. BEDFORD (*Canada Exptl. Farms Rpt. 1893, pp. 267–269*).—Notes and tabulated data on varieties of corn, lettuce, cauliflower, rhubarb, and tomatoes tested at the Manitoba Experimental Farm. The early varieties produced fair yields.

Miscellaneous vegetables, T. A. SHARPE (*Canada Exptl. Farms Rpt. 1893, pp.*

336, 337).—Notes on cauliflowers, millet, hemp, jute, peanuts, and sunflowers grown at the British Columbia Experimental Farm.

Vegetables and flowers, A. MacKay (*Canada Exptl. Farms Rpt. 1893, pp. 292–301*).—Notes and tabulated data for several kinds of garden vegetables and ornamental plants at the Northwest Territory Experimental Farm.

On the comparative merits of steam and hot water for greenhouse heating, F. W. Card (*New York Cornell Sta. Rpt. 1892, pp. 157–193*).—A reprint of Bulletin 41 of the station (E. S. R., 4, p. 348).

Second report upon electro-horticulture, L. H. Bailey (*New York Cornell Sta. Rpt. 1892, pp. 195–212*).—A reprint of Bulletin 42 of the station (E. S. R., 4, p. 349).

The conservation of fresh fruit, Gaerdt (*Fühling's landw. Ztg., 43* (*1894*), *No. 20, pp. 643–645*).—A popular article giving general rules.

Shipping bananas and pineapples, W. Fawcett (*Bul. Bot. Dept. Jamaica, 1* (*1894*), *No. 8 and 9, p. 121*).—Brief notes on the methods of packing employed in shipping these fruits from the West Indies to England.

Preserving mangoes, E. M. Shelton (*Bul. Bot. Dept. Jamaica, 1* (*1894*), *No. 7, pp. 111, 112*).—Recipes for preserving mangoes, giving at length directions for canning them and for making them into marmalade and jelly. Thirteen good-sized mangoes were found to give 1 pt. of jelly and 5 qts. of marmalade, and stewed mangoes are considered equal in flavor to stewed peaches.

Utilization of bananas for meal, alcohol, etc., W. Fawcett (*Bul. Bot. Dept. Jamaica, 1* (*1894*), *No. 7, pp. 115–117*).—Brief mention of various uses of bananas in the manufacture of yeast, malt, alcohol, and glucose, and the suitability of banana flour for bread and cakes, either employed alone or mixed with wheat or rye flour.

Apple culture in Ontario, W. W. Hillborn (*Ontario Agl. Col. and Exptl. Farm Rpt. 1893, pp. 286–288*).—General remarks on the selecting of trees, planting, cultivating, and manuring for apple orchards.

The cultivation of native plums and cherries, L. H. Bailey (*New York Cornell Sta. Rpt. 1892, pp. 27–112, figs. 14*).—A reprint of Bulletin 38 of the station (E. S. R., 4, p. 162).

Mulberries, L. H. Bailey (*New York Cornell Sta. Rpt. 1892, pp. 303–333, figs. 9*).—A reprint of Bulletin 46 of the station (E. S. R., 4, p. 552).

The influence of stock grafting, G. Couderc (*Prog. Agr. et Vit., 11* (*1894*), *No. 41, pp. 397–404; No. 45, pp. 500–505*).—A paper treating of the effect of different grafts on the vigor of the vine in various soils and to resist chlorosis.

Manuring of the vine, G. Foëx (*Prog. Agr. et Vit., 11* (*1894*), *No. 40, pp. 378–381; No. 41, pp. 397–404*).—A discussion of the best fertilizers for grapevines and the methods of applying them.

Rose industry of Luxemburg, Murphy (*U. S. Consular Rpt. 1894, Sept., p. 139.*)—A brief note on the extent of rose growing in Luxemburg.

A district fruit list adapted to the province of Quebec, J. Craig (*Canada Exptl. Farms Rpt. 1893, pp. 102–109*).—The 62 counties of the province are grouped into 13 districts, and lists are given comprising the varieties of apples, pears, plums, cherries, grapes, raspberries, blackberries, gooseberries, currants, and strawberries believed to be best adapted to each section.

New fruits, J. Craig (*Canada Exptl. Farms Rpt. 1893, pp. 95–100, figs. 4*).—Descriptive notes on 12 varieties of grapes, 2 of raspberries, and 2 of apples, new to the experimental farm, and giving satisfactory fruit.

Fruits, A. MacKay (*Canada Exptl. Farms Rpt. 1893, pp. 301–303*).—Notes on apples, plums, cherries, currants, raspberries, strawberries, gooseberries, and huckleberries at the Northwest Territory Experimental Farm. As a rule they withstood the climate and produced fair crops.

Fruit, T. A. Sharpe (*Canada Exptl. Farms Rpt. 1893, pp. 337–346*).—Notes on apples, pears, plums, cherries, nectarines, peaches, apricots, figs, grapes, nuts, gooseberries, currants, raspberries, blackberries, and strawberries. The apricots, figs, and grapes suffered much from a severe winter.

Tea culture in Japan, W. H. ABERCROMBIE (*U. S. Consular Rpt. 1894, Sept., pp. 130–132*).—A report on the growing of tea in the several provinces of Kiushiu, giving the statistics, and brief notes on the cultivation. In 1893, 1,148,149 caddies (1.31 lbs.) of tea were manufactured.

FORESTRY.

The cultivated poplars, L. H. BAILEY (*New York Cornell Sta. Bul. 68, pp. 205–238, figs. 18*).—This bulletin contains general remarks upon poplars as applied to landscape gardening and illustrated descriptions of 12 species of cultivated poplars.

It is recommended that poplars be employed only as secondary trees in landscape gardening, and that they should be sparingly planted in situations carefully chosen for their artistic effect. The Lombardy and silver-leaved or white poplars are preferred less than species with heavy, dark foliage and strong growth. For ornamental planting cottonwoods and aspens are suggested, and for shelter belts and timber, Certinensis poplar, cottonwood, and balm of Gilead.

The following species and varieties are described: Yellow poplar (*Populus angustifolia*), balsam poplar or tacmahac (*P. balsamifera*, vars. *intermedia*, *viminalis*, and *latifolia*), balm of Gilead (*P. candicans*), *P. simonii*, Certinensis poplar (*P. laurifolia*), cottonwood (*P. monilifera*), black poplar or Lombardy poplar (*P. nigra*, vars. *elegans* and *italica*), European aspen (*P. tremula*), large-toothed aspen (*P. grandidentata*), common aspen or popple (*P. tremuloides*), *P. sieboldi*, and white poplar (*P. alba*, vars. *canescens*, *nivea*, and *bolleana*).

Uses of the eucalyptus tree (*U. S. Consular Rpt. 1894, Sept., pp. 1–20*).—Reports from consular officers at Bordeaux, Marseilles, Nice, Florence, Rome, Lisbon, Barcelona, Calcutta, Havana, and Zanzibar in regard to the limit of cold endurance of the eucalyptus, and the hygienic effect of eucalyptus plantations, especially in regard to malaria. The lowest temperature given at which any species escapes injury is 17.6° F., and many species can not endure a freezing temperature. The opinions vary as to the value of the tree in preventing malaria, but it seems to be established that its power in this respect has been overestimated, and that though the miasma may be somewhat abated, the effect is probably due rather to the abundant roots drying the soil than to any exhalations from the tree. The economic value in furnishing timber, gums, perfumers' essences, antiseptic and essential oils, and material for manufacturing packing and blotting paper is touched upon.

Notes on rubber plants, W. FAWCETT (*Bul. Bot. Dept. Jamaica, 1 (1894), No. 7, pp. 99–111*).—Notes are given on the source, conditions of soil, temperature, and rainfall for growth of plants, and methods of collection and preparation for the market of some of the principal kinds of rubber. Plants enumerated as under cultivation in Jamaica are Para rubber from *Hevea brasiliensis* and *H. spruceana*, Assam rubber from *Ficus elastica*, and Jamaica rubber from *Forsteronia floribunda*.

Plantations of forest trees, W. SAUNDERS (*Canada Exptl. Farms Rpt. 1893, pp. 51–55, pl. 1*).—Notes on the belts and clumps of forest trees planted on the experimental farm, with a detailed account of the planting and condition. They have made rapid growth and suffered but slight mortality. Lists are given, showing the species of deciduous and evergreen trees planted, with the dates of planting and number of trees set out.

Experiments in fall and spring transplanting, J. CRAIG (*Canada Exptl. Farms Rpt. 1893, pp. 112–115*).—Thirty each of 3-year-old trees, from 8 to 10 ft. high, of green ash, black walnut, red oak, and European mountain ash were transplanted in the fall of 1892, 10 being planted without pruning, 10 with three fourths of the last season's growth removed, and 10 with the tops cut back to the main stems. In the following spring a duplicate collection was transplanted and treated in a manner similar to that set out in the fall. In the subsequent fall a comparison was made, and the fall-planted trees were found to possess much more dead wood, sun scalds, and uneven growth than those spring planted. As a result, spring planting is advised in most cases. The details of the experiment are shown in an accompanying table.

Pruning oaks in midsummer, J. CRAIG (*Canada Exptl. Farms Rpt. 1893, p. 115*).—A number of young oaks were cut back to 1, 2, 3, and 4-year-old wood, respectively, with the result that those pruned to the 3-year-old wood made vigorous, large growths, while all the others were injured or killed.

Ornamental trees and shrubs, W. SAUNDERS (*Canada Exptl. Farms Rpt. 1893, pp. 46–51*).—The ornamental planting on the Central Experimental Farm consists of 35 closely or openly planted clumps containing 1,789 trees and shrubs of 225 named species and varieties. A list is given showing the botanical and common names, and the hardiness of the plants. In the arboretum over 600 species and varieties are arranged in botanical groups.

Propagation of ornamental shrubs and conifers, J. CRAIG (*Canada Exptl. Farms Rpt. 1893, pp. 115–117*).—Various shrubs and conifers were grown from cuttings which were made both from the ripened and from the green wood. There seemed to be little difference in the results.

Trees and shrubs, S. A. BEDFORD (*Canada Exptl. Farms Rpt. 1893, pp. 262–267, figs. 2*).—A report on the trees and shrubs set out in nursery rows and shelter belts, the rate of growth, condition, species, and varieties planted; number of trees distributed, and tabulated notes on experiments with trees as wind-breaks. The Russian poplar (*Populus bereolensis*) and *Salix acutifolia* are proving most promising for windbreaks. The ash-leaf maple is forming good hedges.

Trees and shrubs, A. MACKAY (*Canada Exptl. Farms Rpt. 1893, pp. 303–305, fig. 1*).—Notes on the trees and shrubs grown on the North-

western Territory Experimental Farm in groves, shelter belts, wind-breaks, and along avenues, with a census of the various species. The Siberian pea tree (*Caragana arborescens*) is considered the best shrub for lawns and *Artemisia abrotanum* for wind-breaks. For hedges, Artemisia willow, Manitoba maple, and poplar rank in value in the order named.

The forest-tree planter's manual, J. O BARRETT (*Minneapolis: Progressive Age Pub. Co., 10th ed., 1893, pp. 128*).—This is a pamphlet dealing with the different phases of timber cultivation, which are treated under several heads. The more important indigenous trees and shrubs are mentioned, and the most prominent ones described in botanical sequence. The management of forest seeds, seedlings, and cuttings is given, and their planting and cultivation detailed. The entomology and general zoölogy of forests are touched upon, as also their climatic, sanitary, and economic values. The subject of Government control of the forests is discussed and advocated.

Studies in forestry, J. NISBET (*Oxford: Clarendon Press, 8vo., pp. 364*).—A series of lectures on the principles of sylviculture delivered at the Botanic Garden, Oxford, in 1893.

Climatic and economic influence of forests, J. NISBET (*Abs. in Agl. Gaz. N. S. Wales, 5 (1894), No. 9, pp 674-676*).

The sprouting of oak stumps and their liability to infection by Agaricus melleus, R. HARTIG (*Forstl. naturw. Ztschr., 3 (1894), No. 10, pp. 428-432*).—The subject is treated in a rather exhaustive manner.

Influence of the age of fir trees on the power of germination of their seeds, CLAUDOT (*Rev. Eaux et Forêts, 1894, No. 21, pp. 511-513*).—Trees of about 150 years produce seed of the highest vitality, as shown by the author's experiments.

Notes on West American conifers, VI, J. G. LEMMON (*Erythea, 2 (1894), No. 11, pp. 173-177*).—Descriptions of the thimble cone pines.

Eucalyptus globosus for swamp planting, J. H. HART (*Roy. Bot. Gard. Trinidad Misc. Bul. 24, pp. 295-297*) —This tree failed in the low regions of Trinidad, while *E. tereticornis* and *E. citriodora* did exceedingly well, being better adapted to tropical conditions.

Hybrid walnut trees, C. S. SARGENT (*Garden and Forest, 7 (1894), pp. 434-436, pl. 1*).—A description and plate are given of a hybrid of *Juglans regia* and *J. cinerea*, and other hybrids, between *J. regia* and *J. nigra*, and *J. regia*, *J. nigra* and *J. californica*, are mentioned.

The culture of willows, VON GULZLAFF (*Deut. landw. Presse, 21 (1894), No. 86, pp. 811, 812*).—A popular article giving the general procedure in osier cultivation.

Valuable tree of New Caledonia, LE MESCAM (*U. S. Consular Rpt. 1894, Sept., p. 142*).—Note on the niaouli tree (*Melaleuoa leucodendron*), stating the value of its timber and of antiseptic distillations from the leaves.

California experiment centers, I, C. H. SHINN (*Garden and Forest, 7 (1894) pp. 442, 443*).—An account is given of the Chico forestry station, its situation, equipment, and lines of work undertaken.

SEEDS—WEEDS.

Contributions from the botanical laboratory and seed control station of Hamburg, O. BURCHARD (*Mittheilungen aus dem botanischen Laboratorium mit Samenprüfungsanstalt in Hamburg, No. 4, 1894, pp. 19*).—The contributions consist of (1) a report on seed testing; (2) report on flour, meal, and feed testing; (3) scientific investigations; and (4) a statement of the other work and the contributions from the laboratory.

During the past year 501 lots of seeds, an increase of 221, were examined, requiring 765 experiments. The seeds were grouped as follows: *Leguminosæ* 315, *Gramineæ* 99, other field crop seeds 43, forest-tree seeds 11, and miscellaneous, 33.

As compared with the report for the previous year (E. S. R., 5, p. 333), the intrinsic value of the following more important seeds showed a higher percentage: *Trifolium pratense*, *Medicago lupulina*, *M. sativa*, *Ornithopus sativus*, *Lolium perenne*, *L. italicum*, *Festuca ovina*, *Phleum pratense*, and *Poa pratensis;* while *Trifolium repens*, *T. hybridum*, *Anthyllis vulneraria*, *Onobrychis sativa*, *Arrhenatherum elatius*, *Festuca duriuscula*, *Dactylis glomerata*, and *Alopecurus pratensis* showed a falling off in value.

The investigation for dodder seed showed that out of 122 of red clover samples, 83 were absolutely free from dodder, of 13 samples of white clover 11 were free. Of lucern 3 out of 6, and timothy 4 out of 9 samples were dodder free.

The probable origin of 101 specimens of seeds, mostly red clover, was investigated, and it was found that in many instances native and American seeds were mixed in the proportion of 2 to 1. Furthermore, what was claimed as Rhenish, Bohemian, and French seed proved on examination to be American. There was no French seed in the market owing to the drought.

Tabular information is given showing the results of farinometer tests of 11 samples of wheat and 4 of rye flour. A microscopic examination of samples of oil cake showed that Indian species of mustard had been substituted as follows: *Sinapis ramosa*, *S. dichotoma*, and *S. chinensis*.

The author has continued his study of American clover seed, endeavoring to determine by means of the weed seed the part of the country in which it was grown. A previous article on this same subject has already appeared.[1]

Culture experiments with *Lespedeza striata*, *Trifolium alexandrinum*, and *T. resupinatum* are reported. *T. alexandrinum* seems little adapted to the region of the station, while the other two plants are to be investigated further, they being now considered as rather promising.

A statement of the activity and publications of the station completes the contributions.

Report of the seed control station, E. HOTTER (*Sta. Fruit Growers' Assn. Middle Styria, 2d Rpt., pp. 35-38*).—During the past year there were examined 105 samples of clover seed, 18 of grass seed, 3 of beet seed, and 5 of miscellaneous seeds. Tests were made as follows: For dodder seed 98, germinative ability 34, genuineness 10, and purity 27; making a total of 169 experiments performed. There were inspected and sealed 603 sacks of red clover seed.

Investigations for admixtures showed, in the case of 1 lot of white

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[1] Landw. Vers. Stat., 43 (1893), No. 3 and 4, p. 239 (E. S. R., 5, p. 911).

clover, 19 per cent plaintain seed. One lot of yellow clover contained 21.6 per cent foreign seed, had a germinative ability of 44.3, and an intrinsic value of 35 per cent. A sample of French rye grass examined showed 45.5 per cent purity. One lot of yellow clover from Buda-Pesth was examined and found to contain 17.7 per cent of foreign matter, 5.2 per cent being flax dodder (*Cuscuta epilinum*) and 12.2 per cent sand and weed seeds. It showed but 27.5 per cent germination, and had an intrinsic worth of only 22.6 per cent.

The station, under contract, tests the seed of several Styrian firms and issues a certificate of good quality, subject to the usual conditions for reëxamination.

Testing of the vitality of grain and other seeds, W. SAUNDERS (*Canada Exptl. Farms Rpt. 1893, pp. 28, 29*).—During the past season the vitality of 1,975 samples of grain and agricultural seeds, from almost every part of the Dominion, were tested and reported upon. The average vitality of all the samples was a little lower than the average of the previous year. Tabular information is given as to the number of samples, the percentage of germination, and the average vitality. Six hundred and thirteen samples of wheat were tested, having a vitality ranging from zero to 100 per cent; 383 samples of barley varied in vitality from 22 to 100 per cent, and 744 samples of oats varied in vitality from 4 to 100 per cent.

A report of seed tested in the spring of 1894 for the Consumers' Union of Schleswig-Holstein (*Landw. Wochenbl. Schles. Holst., 44* (*1894*), *No. 43, pp. 592, 593*).—All the seeds tested were guaranteed, and the results of the tests of some of the more common seeds, compared with the guarantee, are as follows:

Results of seed testing.

Kind of seed.	Guarantee.			Result of testing.		
	Purity.	Germinative ability.	Intrinsic worth.	Purity.	Germinative ability.	Intrinsic worth.
	Per cent	*Per cent.*	*Per cent.*	*Per cent*	*Per cent.*	*Per cent.*
Red clover	97.5	90	87.70	97.12	91.50	88.87
Crimson clover	97.0	98	96.00	96.80	96.00	92.90
White clover	98.0	85	83.30	96.60	83.75	80.90
Lucern	97.0	85	82.40	96.40	84.00	81.00
Serradella	97.0	86	83.40	95.30	39.00	77.43
Timothy	99.0	99	98.00	98.70	98.00	96.70
English rye grass	99.0	93	92.07	98.10	96.00	94.70
Meadow foxtail	95.0	85	80.75	94.00	88.00	82.70
Orchard grass	91.0	95	86.40	88.40	97.00	85.70
Blue grass	88.0	75	66.00	87.60	90.00	78.80
Soft brome	75.0	50	37.50	69.10	93.00	64.30
Spurry	93.0	80	74.00	92.20	91.00	83.90

There were examined 66 samples of seed, representing 36 species of plants. A table is given showing the percentage of admixtures and also the botanical species of weed and other seeds present.

Duration of the vitality of some agricultural seeds, J. SAMEK (*Tirol. landw. Blätter, 13* (*1894*), *No. 18, pp. 161, 162*).—In order to test

the question of the duration of the vitality of seeds the author took 20 lots of well-matured, fresh seed, and examined a portion of them each year from 1883 to 1894. The unused portions were kept in paper bags in a dry, airy room. The tabulated results of his examinations are given below. In some cases but a single sample of seed was tested each year, but in most the figures given are the average of 3 samples tested.

Result of 11 years' seed testing.

Kind of seed.	Percentage of vitality.										
	1 yr.	2 yr.	3 yr.	4 yr.	5 yr.	6 yr.	7 yr.	8 yr.	9 yr.	10 yr.	11 yr.
Red clover (*Trifolium pratense*)	90	90	88	84	74	68	44	16	10	3	2
White clover (*Trifolium repens*)	74	72	63	52	50	50	35	31	26	23	22
Alsike clover (*Trifolium hybridum*)	73	64	51	37	15	7	6	5	3	3	3
Esparcet (*Onobrychis sativa*)	92	92	78	61	54	52	19	18	13	9	(1)
Serradella (*Ornithopus sativus*)	36	32	33	22	14	11	9	6	2	0	0
Alfalfa (*Medicago sativa*)	94	91	87	75	72	71	68	66	63	59	54
French oat grass (*Avena elatior*)	70	66	59	43	24	12	10	2	1	0	0
Italian rye grass (*Lolium italicum*)	67	62	61	55	43	39	29	15	8	4	1
English rye grass (*Lolium perenne*)	72	70	66	60	42	28	22	9	5	1	0
Tall fescue (*Festuca pratensis*)	83	80	72	68	48	42	35	18	9	1	0
Sweet vernal grass (*Anthoxanthum odoratum*)	70	62	57	46	43	37	31	13	9	8	4
Meadow foxtail (*Alopecurus pratensis*)	13	11	9	7	7	5	3	1	1	0	0
Timothy (*Phleum pratense*)	95	90	90	88	86	79	66	39	15	1	0
Orchard grass (*Dactylis glomerata*)	46	47	44	44	38	29	21	12	8	5	(1)
Blue grass (*Poa pratensis*)	28	17	17	17	16	11	8	5	2	0	0
Crested dogstail (*Cynosurus cristatus*)	46	39	33	29	20	12	6	3	2	1	0
Fiorin (*Agrostis stolonifera*)	66	61	46	43	37	35	34	31	22	20	(1)
Sheep fescue (*Festuca ovina*)	68	67	68	42	21	18	10	4	3	0	0
Hair grass (*Aira flexuosa*)	37	27	21	17	7	3	0	0	0	0	0
Spurry (*Spergula arvensis*)	85	70	68	59	46	42	37	25	21	8	2

[1] No seeds for examination, all having been used up in the previous years.

Impurities in clover seed, J. H. PANTON (*Ontario Agl. College Bul. 98, pp. 8, figs. 10*).—The author examined 60 samples of clover seed received from various sources, testing it for its purity, genuineness, and vitality. All samples were true to name. Fifty-three contained weed seeds in varying quantities, the most abundant being seeds of white cockle (*Lychnis vespertina*), sorrel (*Rumex acetosella*), campion (*Silene inflata*), chicory (*Cichorium intybus*), rib grass (*Plantago lanceolata*), ragweed (*Ambrosia artemisiæfolia*), smartweed (*Polygonum pennsylvanicum*), chess (*Bromus secalinus*), and black bindweed (*Polygonum convolvulus*). Of these seeds enlarged and natural-sized figures are given. The number of weed seeds in $\frac{1}{2}$ oz. and the probable proportion of weeds to clover plants in a square yard seeded at the usual rate are given. The vitality varied from 49 to 98 per cent, with an average of all samples of over 90 per cent.

Methods of planting and destroying Bermuda grass, C. L. NEWMAN (*Arkansas Sta. Bul. 28, pp. 103–108*).—Directions for planting are given. In an experiment on methods of destroying this grass satisfactory results were secured (1) by plowing with a heel sweep at intervals of from 1 to 3 weeks throughout the season; (2) by growing a crop of oats and afterwards following with the above treatment for the remainder of the season; (3) by growing a crop of oats and for the rest of the season

plowing with a scooter plow at intervals of 1 to 3 weeks; and (4) by growing a crop of oats followed by a crop of cowpeas planted in drills 2½ ft. apart and cultivated twice.

On the germination of oily seeds, LECLERC DU SOOLON (*Compt. Rend., 119 (1894), No. 15, pp. 610–612*).

Photographing of seed and an apparatus designed for that purpose (*Eder's Jahrb. Phot. u. Reproductiontechnik, 1893, pp. 5; abs. in Bot. Centbl., 60 (1894), No. 7, p. 202*).

The Russian thistle in Illinois, G. E. MORROW (*Illinois Sta. Bul. 35, pp. 4, pls. 2*).—A popular bulletin giving information regarding the Russian thistle (*Salsola kali tragus*). It has been reported from 9 stations in the State, and its presence can be rather easily traced to the northwestern region, where it abounds.

Cyperus rotundus, J. H. HART (*Roy. Bot. Gard. Trinidad Misc. Bul. 24, p. 303*).—The author briefly describes the presence of this pernicious weed and recommends the thorough working over of the ground and picking out the roots every 7 or 8 days. It is commonly known in Trinidad as devil grass, or coco-chatte.

The destruction of weeds, WITTMACK (*Fühling's landw. Ztg., 43 (1894), No. 9, pp. 593–597*).

Weeds of Ontario, J. H. PANTON (*Ontario Agl. College and Exptl. Farm Rpt. 1893, pp. 27–31, figs. 4*).—A reprint from Bulletin 91 (E. S. R., 5, p. 529).

DISEASES OF PLANTS.

Crown knot, J. W. TOUMEY (*Arizona Sta. Bul. 1, 2d ser., pp. 11*).—The author gives a preliminary report of observations on the crown knot of fruit trees and vines. Although affecting almost all deciduous fruits, it has thus far been most destructive to the peach. This disease has already been described in California Bulletin 99 (E. S. R., 4, p. 563). The author found white ants (*Termes flavipes*) nearly always present in the knots, hastening the destruction of the tree. As yet no definite cause is known for the disease, but it is thought that the tendency of some orchardists to irrigate too frequently and too much, and to endeavor to make irrigation take the place of cultivation may influence their formation, as orchards under proper irrigation and cultivation are usually free from the disease, while others growing by their side, but improperly tended, are badly diseased.

Care in selecting young trees, digging up and burning all badly affected ones, pruning away the knots, and treating the wounds with some antiseptic in the case of slightly affected ones, are the remedies recommended.

Pear and apple blight, J. CRAIG (*Canada Exptl. Farms Rpt. 1893, pp. 88–95*).—A historical statement is given of the discovery and spread in America of the disease variously known as apple blight, pear blight, fire blight, and twig blight. Various authors are quoted on the cause and means for spreading this disease.

Compiled information is tabulated showing the spread and extent of the disease throughout the Dominion. The date of appearance, character of the injury, varieties affected, and effect of cultivation are given. Of the replies received to the author's inquiry, 44 per cent

noticed no difference in the relative prevalence of blight on cultivated ground, 38 per cent showed less blight in orchards in sod, and 17 per cent were in favor of high cultivation. The disease so far seems to be confined to the provinces of Ontario and Quebec. A sketch is given of the disease in Ontario and at the experimental farm, and practical suggestions offered as to means for its prevention.

Some results of recent investigations on the grain rusts, J. ERIKSSON and E. HENNING (*Kgl. Landt. Akad. Handl. Tidskr., 33 (1894), pp. 161–177*).—A monograph of the grain rusts, giving their physiology, experiments in preventive treatment, etc. The varieties studied are *Puccinia graminis*, *P. phlei-pratensis*, n. sp., *P. glumarum*, *P. dispersa*, n. sp., *P. simplex*, and *P. coronata*.—F. W. WOLL.

Sugar-cane disease, W. FAWCETT (*Bul. Bot. Dept. Jamaica, 1 (1894), No. 7, p. 111*).—Attention is called to a disease of sugar cane in Jamaica. The fungus causing the disease attacks the roots and was determined by G. Massee as *Colletotrichum falcatum*. The disease may be recognized by the affected rootlets becoming soft and decayed. The whole cane should be taken up and burned and some other crop cultivated in the infested soil for a few years. In selecting cane for planting strong and healthy tops should be used, and it is advisable to get them from districts where the disease does not exist.

Aureobasidium vitis, a disease of the grapevine, P. ELOSTE (*Compt. Rend., 119 (1894), No. 12, pp. 517, 518; also Jour. Agr. Prat., 58 (1894), No. 39, pp. 461, 462*).—The author reports the occurrence of this disease in the Department of Hérault. It first appeared in 1893 and in this season it had spread quite generally throughout the department. The nature of the attack on the host is fully described and the fungus determined as *Aureobasidium vitis*, which has already been described (E. S. R., 6, p. 230). Bordeaux mixture and a wash of a solution of iron sulphate have been used without any considerable effect as preventive remedies.

On the gummosis of grapevines, L. MANGIN (*Compt. Rend., 119 (1894), No. 12, pp. 514–516; also Jour. Agr. Prat., 58 (1894), No. 39, pp. 459–461*).—The author thinks the gum and mucilage found in the vessels of the grapevine are secreted by certain specific cells in a definite way, and are not caused by the presence of bacteria or other organisms. He claims the appearance of such organisms is subsequent to and not the cause of the formation of gum in the grape. Attention is called to the fact that gum secretion is not confined to the grape, but is found in many of the *Rosaceæ*, *Acacia* spp., etc. The conditions for the production and appearance of the gum are still to be the subject of further study.

The effect of spraying with fungicides on the growth of nursery stock, B. T. GALLOWAY (*U. S. Dept. Agr., Division of Vegetable Pathology Bul. 7, pp. 41, figs. 17*).—Nursery stock, particularly pears, cherries, plums, and apples, is especially subject to various fungus diseases producing (1) in the case of seedlings ripened wood so that the buds can

not be inserted, or an imperfect union of bud and stock, and (2) a stunted development due to the annual early loss or drying up of the leaves. Experiments conducted in 1889 and 1890 showed that these diseases could be prevented by the use of fungicides. Another series of experiments was conducted at Mulliken, Maryland; beginning in 1891 and ending in 1893. The treatment was to begin with the seedling and end when the trees were of marketable size. Incidentally, the resistance of certain stocks was to be considered. The first year different stocks were budded at the same time and record kept of the date and number of applications, conditions of growth, and amount of material and cost of spraying. The second year the growth of buds, resistance, time, and amount of material needed to spray the trees were noted. The third year notes and measurements were taken and the time and amount of material again noted; and finally the stock was graded and photographed. The fungicides used were Bordeaux mixture, ammoniacal copper carbonate, and potassium sulphid, the formulas of which are given. Different numbers of sprayings were given different plats, 5, 6, and 7 applications being given the different plats for the first 2 years. The third year the plats which had received 7 sprayings received 6 and the other 5 applications. The more important points brought out by the experiments are summarized by the author as follows:

"(1) The treatment had comparatively little effect on the apples; that is, the untreated trees were, from the beginning to the end of the experiment, practically as good as the treated. It must be borne in mind, however, that powdery mildew, the only fungus that seriously interferes with the growth of the apple in the nursery, was almost entirely absent during the progress of the work.

"(2) The most striking results of the work were seen in the case of the pears, cherries, and plums, in the order named.

"(3) Bordeaux mixture in every instance gave the best results, materially increasing the growth of the pears and cherries, and never in any case injuring the foliage in the slightest. As pointed out in other publications of this division, the remarkable effect of this mixture can not be wholly accounted for on the ground of its efficiency as a fungicide or insecticide. It certainly possesses qualities aside from those mentioned, and these qualities, when well understood, it is believed will prove of considerable practical importance.

"(4) There was no appreciable difference as regards growth between stocks treated early and those treated late. In other words, withholding the application of the fungicide 10 to 15 days in spring did not materially affect the result so far as growth was concerned. In some cases the plats sprayed 7 times seemed to be better than those which received 5 sprayings, but the differences were so slight as to be hardly worthy of notice.

"(5) As regards the effect of the stock on the bud, it may be said that the experiments showed nothing striking, excepting that the Japan pear roots in almost every case gave the best growth. An exception to this, however, occurred in case of Tyson, which made the best growth on French roots.

"(6) The treatments did not seem to produce any marked effect on stocks so far as rendering them more easily budded. These results may in a measure be accounted for, however, by the fact that the leaf-blight diseases were not so severe during the early part of the season of 1891 as usual.

"(7) The cost of treating nursery stock with Bordeaux mixture, the only preparation that can be unqualifiedly recommended, need not exceed 25 cts. per 1,000 trees the first season. The second year the cost of the work will also be 25 cts., while the third year the cost will be increased to 35 or 40 cts. per 1,000, making the total cost of treating trees until the buds are 2 years old from 85 cts. to $1 per 1,000.

"(8) The net profit resulting from the work in case of the pears and cherries ranged from $1 to $40 per 1,000 trees, the average being $13 per 1,000.

"(9) In conclusion it may be said that as a whole the experiments clearly show that spraying nursery stock with fungicides is thoroughly practicable; that it results in better trees in every way; and finally, that it yields a handsome profit."

The growth of pear seedlings as affected by one season's spraying with Bordeaux mixture was investigated. One hundred Japanese and the same number of French seedlings were taken as nearly uniform as possible. Bordeaux mixture was applied 5 times, the formula for the fungicide being, copper sulphate 6 lbs., lime 4 lbs., water 45 gal.

Records of weight, height, and size of seedlings were taken and compared with the same factors at the end of the experiments. In conclusion, it is shown that:

"(1) Five applications of Bordeaux mixture had a decided effect on the growth of both Japanese and French pear seedlings, increasing their weight, height, and caliper to a marked extent in almost every case.

"(2) The Japanese seedlings in all cases proved more vigorous than the French, but whether this would hold true in all sections of the country remains to be proved."

Spraying experiments, J. CRAIG (*Canada Exptl. Farms Rpt. 1893, pp. 100, 101*).—A report is given on the use of Bordeaux mixture and ammoniacal copper carbonate as a protection against codling moth and apple spot. The season was not a favorable one for the pests and the results are rather inconclusive. Bordeaux mixture and Paris green were employed, and it is claimed that the poisonous action of the arsenite is diminished by adding it to the fungicide when used on the apple, pear, and plum trees. When used as preventives against the currant worm and gooseberry mildew the combination proved very effective.

Effect of dilute sulphuric acid on foliage, J. CRAIG (*Canada Exptl. Farms Rpt. 1893, pp. 101, 102*).—A report is given on the use of dilute sulphuric acid as a fungicide. Single applications of $\frac{1}{4}$, $\frac{1}{2}$, 1, and $1\frac{1}{2}$ per cent solutions were made. All strengths injured the foliage of apple, grapes, and plums in the orchard. In the greenhouse, rose leaves (young and mature), strawberry, geranium, and hibiscus were sprayed. The $\frac{1}{4}$ and $\frac{1}{2}$ per cent solutions did no injury except to the mature rose foliage and hibiscus. Strengths of $\frac{1}{2}$ per cent and more injured the strawberry leaves, and only the young rose leaves withstood considerable injury for all strengths. The injury seems to be caused by the evaporation of the water used to dilute the solution, leaving it too strong. When applied to roses as strong as $1\frac{1}{2}$ per cent solution it apparently had no effect on the aphides which infested them.

Is Bordeaux mixture detrimental to the yield of potatoes in dry seasons? J. SAMEK (*Tirol. landw. Blätter, 13 (1894), No. 8, pp. 68–70*).—The author sprayed 6 varieties of potatoes with Bordeaux mixture to ascertain its effect upon the yield during a dry season. Three applications were made on the following dates: June 2, June 26, and July 26. But 2 varieties were affected by the disease and the plats on which these grew gave 2.53 and 2.37 per cent rotten tubers. The total yield of the 6 varieties is practically the same for treated and check plats. In 3 varieties the yield of the treated plats was greater than their checks by 21.5, 2.8, and 2.7 per cent, respectively. In the others the greater yield was in favor of the untreated plats, the percentages of increase being 14.2, 11.9, and 1.6.

Bordeaux mixture for the prevention of potato rot, W. M. BLAIR (*Canada Exptl. Farms Rpt. 1893, p. 222*).—Experiments were conducted by the author on the experimental farm at Nappan, Nova Scotia, with Bordeaux mixture as a preventive of the potato rot. Two applications were given to 13 varieties, half of each plat being left untreated. With some varieties there were more pounds of rotten potatoes on the treated than on the untreated parts of the plat, but most showed a slight advantage in favor of the treated plats. In all but 4 varieties the total yield of the treated plats was greater than that of the checks.

Bordeaux mixture for potato rot, T. A. SHARPE (*Canada Exptl. Farms Rpt. 1893, p. 336*).—A plat of potatoes at the experimental farm of British Columbia was given 4 applications of Bordeaux mixture for the prevention of rot. The sprayed tops were vigorous and healthy until ripe, there being no blight on them, while the plants on the check plat were badly affected. When harvested the yield was 248 bu. per acre from the untreated plat, 75 per cent of which were marketable, as compared with 270 bu. from the treated plat, 85 per cent of which were marketable.

Spraying for rust, W. SAUNDERS (*Canada Exptl. Farms Rpt. 1893, p. 33*).—Experimental plats of oats and wheat were sprayed with a solution of copper carbonate. On some of the plats a second spraying was given, but there was no perceptible difference between the sprayed and unsprayed portions, and the fungicide seemed to have no effect in preventing attacks of rust.

Smut in wheat, W. SAUNDERS (*Canada Exptl. Farms Rpt. 1893, p. 41*).—A copy of a circular addressed to the farmers of Manitoba and the Northwest Territory is given in which the bunt or stinking smut of wheat is described, and directions given for applying a solution of copper sulphate (1 lb. in 3 gal. of water to 10 bu. of seed wheat). This is sprinkled over the wheat, the grain stirred thoroughly so that every grain may be wet. The seed should be sown shortly after the treatment as the fungicide lessens in some degree the germinating power of the wheat, especially when it remains long in contact with it. Tests have been conducted at some of the farms showing that it is the

easiest of application, the cheapest, and most efficient method to be pursued for the prevention of this disease.

Copper sulphate as a smut preventive, S. A. BEDFORD (*Canada Exptl. Farms Rpt. 1893, pp. 237, 238*).—Experiments were conducted at the experimental farm for Manitoba on the use of copper sulphate as a preventive of smut on oats. The seed oats were sprinkled with a solution of the fungicide at the rate of 1 lb. to 5 bu., and 1 lb. to 10 bu., and then sown at the rate of 6 pecks per acre. In each case about 30 per cent less smutty heads were found in the treated plats, and they yielded 6 to 7½ bu. per acre more than the untreated ones.

The treatment of diseased sugar canes in the West Indies (*Proc. Leeward Islands Agl. and Commercial Soc., 1894, Aug. 3, p. 8*).—The suggestions offered by the authorities at Kew for the repression of cane diseases are: (1) Selection of healthy plant tops, (2) use of disinfectants on tops before planting, (3) cutting out of all diseased canes as far as possible, and (4) burning of all diseased or rotton canes as fast as possible after harvest, together with all trash left in the fields.

All these methods have been pursued except the last, and it is suggested to destroy the spores of the fungus by applying to the trash solutions of corrosive sublimate, Bordeaux mixture, or other fungicides. It is thought this treatment will prove effective, and the cultivator will not lose the trash and tops, which are very necessary to the fertility of the soil.

A chytridinous parasite of the vine, A. PRUNET (*Compt. Rend., 119 (1894), No. 14, pp. 572–574*).—Description and life history of the fungus *Cladochytrium viticolum*.

Joint parasitism of Æcidium punctatum and Plasmopara pygmæa on Anemone ranunculoides, P. VUILLEMIN (*Bul. Soc. Bot. France, 41 (1894), No. 6 and 7, pp. 442–446*).

Completoria complens, G. F. ATKINSON (*Bot. Gaz., 19 (1894), No. 11, pp. 467, 468*).—Report of the occurrence of this fungus, closely related to the *Entomophthora* parasite on fern prothallia.

Investigations on the morphology and anatomy of sprout and leaf deformations due to Exoasceæ, I, W. G. SMITH (*Forstl. naturw. Ztschr., 3 (1894), No. 11, pp. 433–465*).

The Exoasceæ of stone fruits, G. F. ATKINSON (*Garden. and Forest, 7 (1894), pp. 463, 464*).—List of species with popular descriptions of their effect on their hosts.

Anatomical investigations of the deformations caused by Gymnosporangium sp., P. WORNLE (*Inaug. Dissertation, 1894, pp. 60; abs. in Bot. Centbl., 60 (1894), No. 9, pp. 280–283*).

Mildew in vineyards, GERMAIN (*U. S. Consular Rpt. 1894, Sept., p. 140*).—An abstract of a circular issued by the Commissioners of Agriculture in Switzerland, giving orders and directions for spraying vineyards with Bordeaux mixture and other fungicide mixtures.

Transformation in the spikelet of Bromus secalinus caused by Phytoptus dubius, MOLLIARD (*Bul. Soc. Bot. France, 41 (1894), No. 6 and 7, pp. 430–433*).

Puccinia malvacearum, W. J. BEAL (*Bot. Gaz., 19 (1894), No. 11, p. 468*).—Report of its occurrence at the Michigan Station.

The Uredineæ of the San Francisco Bay region, W. C. BLASDALE (*Asa Gray Bul., 1893, No. 3, pp. 2; abs. in Bot. Centbl., 60 (1894), No. 7, pp. 204, 205*).

Downy mildew of grape, O. KIRCHNER (*Württ. Wochenbl. Landw., 1894, No. 38, pp.*

501, 502).—Report of the finding of *Peronospora viticola* in Stuttgart, together with description of the parasite and its effect on the host, with preventive treatment suggested.

On grain rust and its prevention, K. DÖHLEN (*Norsk Landmandsblad, 13* (*1894*), *pp. 411–413*).

Abnormal root swelling of Ailanthus, E. ANDREAE (*Inaug. Dissertation; abs. in Bot. Centbl., 60* (*1894*), *No. 6, pp. 187, 188*).

On a disease of Ailanthus in the parks and promenades of Paris, L. MANGIN (*Compt. Rend., 119* (*1894*), *No. 16, pp. 658–661*).

A serious blight of Cosmos, B. D. HALSTED (*Garden and Forest, 7* (*1894*), *pp. 464, 465, figs. 2*).—Report of the attack of *Cosmos* by a species of *Phyctæna* probably new.

The cause and treatment of pear-leaf rust, F. RAUCH (*Würt. Wochenbl. Landw., 1894, No. 30, pp. 396, 397*).—The author discusses *Gymnosporangium fuscus* and its attack on pear foliage.

The potato rot, P. ASPER (*Landw. Wochenbl. Schles. Holst., 44* (*1894*), *No. 41, pp. 564, 565*).

Observations on bacterial gummosis of the vine, L. DAILLE (*Compt. Rend., 119* (*1894*), *No. 18, p. 751*).

On the appearance of wheat mildew, M. HOLLRUNG (*Ztschr. landw. Cent. Ver. Sachsen, 1894, No. 7, pp. 255–257*).—An account is given of the appearance in Saxony of *Erysiphe graminis*, together with notes on its habits and spread.

A disease of sugar cane in Mauritius, P. BONAME (*Sucrerie indigène, 44* (*1894*), *No. 14, pp. 393–398*).

The variable action of sulphate of copper on Isaria farinosa, G. SAUVAGEAU (*Bul. Herb. Boissier, 2* (*1894*), *No. 10, pp. 633–638*).

Salt water as a preventive of peach yellows, M. H. BECKWITH (*Garden and Forest, 7* (*1894*), *pp. 448, 449*).—The author cites orchards overflowed by high tides as showing no decrease in the yellows, and he thinks salt is of little value in combating the disease.

Bordeaux mixture and the potassium ferrocyanid test, E. G. LODEMAN (*Garden and Forest, 7* (*1894*), *pp. 456, 457*).—The author mentions an obscure blemish on sprayed fruit, especially apples. The most severe cases occurred where trees had been sprayed with Bordeaux mixture tested with potassium ferrocyanid. He thinks an addition of lime would probably obviate the difficulty, and recommends that the formula 6 lbs. copper, 4 lbs. lime, and 40 to 60 gal. water be employed.

Remedies for common plant and insect foes, J. H. PANTON (*Ontario Agl. Col. and Exptl. Farm Rpt. 1893, pp. 22–27*).—A reprint of Bulletin 87, giving formulas for fungicides and insecticides and the most approved remedies for different common fungus diseases and insect pests.

Spraying apple orchards in a wet season, E. G. LODEMAN (*New York Cornell Sta. Rpt. 1892, pp. 357–393*).—A reprint of Bulletin 48 of the station (E. S. R., 4, p. 561).

ENTOMOLOGY.

The horn fly, H. E. WEED (*Mississippi Sta. Bul. 28, pp. 8, figs. 3*).—A more or less compiled account of the horn fly (*Hæmatobia serrata*), giving description, life history, habits, and remedies. The pest was first noticed in the State in 1891, and has since become very abundant. It is recommended that a mixture of 2 parts crude cotton-seed oil or fish oil and 1 part pine tar be applied by means of a large paint brush to the flanks, back, forequarters, and horns of the cattle at milking time to keep off the flies. A fresh application should be made every week or 10 days. Spraying the clusters of the flies with kerosene

emulsion was found to be the best means of killing them. It is believed that the numbers of the pest will soon be much lessened through the action of parasites.

The "flaxseed stage" of the Hessian fly, A. LABOULBÈNE (*Compt. Rend., 119 (1894), No. 4, pp. 297–300*).—Notes on the metamorphoses of *Cecidomyia destructor*, and upon the puparium, or envelope, of its larva before transforming to a chrysalis. Microscopical examination shows that before the formation of the flaxseed stage there is a moist exudation, after which the body becomes rigid and brown. Treatment with caustic potash renders the flaxseed less opaque, and permits recognition of the granules of the integument, and, without great difficulty, of the larval stigmata. The author concludes that it is by a molt, with a considerable thickening of the pre-existing skin, that the larva of the Hessian fly encysts itself. The previous chemical examinations of Giard show that the substance of the flaxseed is identical with that which constitutes the tegumentary envelope of the larva, and that it offers the characteristic reactions of chitin, especially by complete resistance to the action of concentrated and even boiling solutions of chlorid of zinc and potash.—L. O. HOWARD.

The scale insects attacking citrus fruits, and methods of combating them, G. DEL GUERCIO (*Staz. Sper. Agr. Ital., 24 (1893), No. 6, pp. 573–592, figs. 6*).—Illustrated descriptive notes on *Mytilaspis fulva*, *Aspidiotus limonii*, *Lecanium hesperidum*, *L. citri*, *Dactylopius citri*, and *Aonidia aurantii*, with remarks on their life history and ravages and experiments and recommendations for treating them. Kerosene and soap emulsion and an emulsion of carbon bisulphid and soapsuds were tried, as also a heavy petroleum oil in different combinations with soap and water. Several styles of spraying apparatus and nozzles were tried, and the Vermorel nozzle preferred. The heavy petroleum oil is considered to give the best results, applied in the following mixture: Petroleum oil 2 lbs., soap 2.4 lbs., water 98 qt.

Further notes on scale insects (Coccidæ), T. D. A. COCKERELL (*Canad. Ent., 1894, Oct., pp. 284–288*).—This describes as new *Tachardia cornuta*, a lac insect, and *Dactylopius solani*, a mealy bug on potato tubers, both from New Mexico. *Orthezia annæ* is recorded from Arizona, *Phenacoccus helianthi* from Texas, and *Diaspis lanatus* from Ceylon. The natural enemies of *Phenacoccus helianthi* are noted, and *Aspidiotus convexus* is discussed.

Insects injurious to stored grain, R. H. PRICE (*Texas Sta. Bul. 31, pp. 463–472, figs. 7*).—This bulletin contains compiled information upon several species of grain-infesting insects, with notes on their occurrence in the State and recommendations for treatment. The following species are described and life histories given: Granary or corn weevil (*Calandra granaria*), rice weevil (*C. oryzæ*), four-spotted bean weevil (*Bruchus 4-maculata*), bean weevil (*B. obtectus*), new bean weevil (*B. rufirmanus*), pea weevil (*B. pisi*), grain beetle (*Silvanus surinamensis*), and Angoumois grain moth (*Gelechia cereallela*).

Seven 1-peck lots of cowpeas which weevils had begun to infest were treated with different insecticides in order to determine their value as preventives. After 4 months the percentage of uninjured peas was determined. In a check lot only 10 per cent of the peas was perfect, while the lot treated with naphthalene presented 91 per cent of uninjured peas. Lime and wood ashes also gave fairly good results when well mixed with the peas; but only 9 per cent of uninjured peas was found in the lot treated with carbon bisulphid. From this test naphthalene is considered the best thing to prevent attacks by weevils, although carbon bisulphid is still preferred to kill them after the stored grain is thoroughly infested.

In order to test the effect of carbon bisulphid on the germinative power of seeds, cowpeas and wheat were subjected to the fumes of the liquid and also to immersion in it. All of the cowpeas germinated, but only 32 to 62 per cent of the wheat survived the treatment, the per cent varying with the time the grain was exposed to the insecticide. Naphthalene was found to produce no bad effect upon wheat, but immersion in mixed sulphur and alcohol for 1 day destroyed the germinative power of 30 per cent of the wheat grains. It is recommended that napthalene be sprinkled in the bins and over the grain to prevent the attacks of weevils, the presence of which can frequently be told by the temperature of the grain rising as though fermentation had begun. Upon their presence being noted carbon bisulphid should be poured over the top of the grain, when the heavy fumes will sink and destroy the pests.

Insect Life (*U. S. Dept. Agr., Division of Entomology, Insect Life, vol. VI, No. 4, pp. 283–346, figs. 11*).—This number contains the following articles:

Special notes (pp. 283–286).—Under this head are comprised remarks upon the eighth and ninth reports of the New York State entomologist, report of the official entomologist of the Dominion of Canada, Miss Ormerod's seventeenth report, Ragonot's monograph of the Phycitinæ and Galleriinæ, and the San José scale in the East.

A new and destructive peach-tree scale (pp. 287–295).—Seedling peaches growing on the grounds of this Department were found in 1892 to be infested by a scale insect which was identified as *Diaspis lanatus*, a pest of the West Indies. The means of its introduction are obscure. It has been received since from Florida and Georgia. A description, life history, and experiments with insecticides are detailed. The female scale is grayish and the male white. The larvæ when they first hatch in May are orange yellow with purple eyes, and become adults in about 4 weeks. There are 3 broods in a season. Kerosene emulsion applied immediately after the young larvæ have hatched is recommended, or uprooting and burning the trees.

The currant-stem girdler, C. L. Marlatt (pp. 296–301).—Notes on the life history of *Phyllœcus flaviventris*, with a technical description of the species, and notes on allied species.

Habits of Stibadium spumosum, M. E. Murtfeldt (pp. 301, 302).—Notes on the larvæ of this moth infesting sunflower heads, with a description of the larvæ and pupæ.

The insect guests of the Florida land tortoise, H. G. Hubbard (pp. 302–315).—General notes on 13 species of insects found inhabiting the burrows of the gopher turtle (*Gopherus polyphemus*). The following species are described as new: *Philonthus gopheri*, *Chelyoxenus xerobatis*, *Copris gopheri*, *Onthophagus polyphemi*, *Aphodius troglodytes*, *Ceuthophilus latibuli*, *Chelanops affinis*, and *Amblyomma tuberculatum*. A rare frog (*Rana areolata æsopus*) was also found in the burrows.

The control of Phylloxera by submersion (pp. 315–318).—A description of this method of treatment as employed in France.

Acorn insects, primary and secondary, M. E. Murtfeldt (pp. 318–324).—Notes on investigations of the insects feeding upon acorns, especially those of the post oak, black oak, laurel oak, pin oak, and black-jack oak, with mention of their parasites. *Balaninus uniformis*, *B. quercus*, *Melissopus latiferreana*, *Callirhytis fruticola*, and *Blastobasis glandulella* were found to be foremost in the destruction of the acorns. The pin oak was found to suffer least from insect attacks, and the post oak and black oak most.

Preliminary report on suppressing the San José scale in Virginia, D. W. Coquillett (pp. 324–326).—A detailed account of the method employed in applying hydrocyanic gas.

Notes from correspondence and general notes (pp. 327–346).—Under this head are mentioned the following: *Icerya montserratensis* in Colombia; kerosene against mosquitoes; the azalea scale in Michigan; scale insects on ivy; wireworm in the burrow of an apple-tree borer; persimmon-root borer; cottonwood scale insects; larvæ in a child's face; clover-leaf beetle in Maryland; galls on the roots of poison ivy; walnut scale on pear; New Jersey's proposed legislation against insects; legislation against insects in Massachusetts; the insects subject to parasitism; Colorado insects; London Entomological and Natural History Society; insects injurious in Nova Scotia; insects of Aldabra, Assumption, and Gloriosa Islands, Indian Ocean; insect pests of Queensland; coffee insects in Hawaii; parasite of the Japanese Gypsy moth; the effect of low temperature upon silkworm eggs; an unusual experience with cabinet beetles; insect damage to beer casks in India; work of the Gypsy Moth Commission in 1893; the cacao bug of Java; bedbugs and red ants; the orange fly in Malta; locusts and cockroaches of Indiana; life history of the chicken dermanyssus; the carnation twitter; application of sulphur for the red spider; russet oranges; does the horn fly attack horses? and the phylloxera in Turkey.

Insect Life (*U. S. Dept. Agr., Division of Entomology, Insect Life, vol. VI, No. 5, pp. 347–405, figs. 8*).—Under special notes are included change in the office of Chief of the Division of Entomology, the periodical cicada, the fluted scale in Florida, recent publications of the

division, new edition of Hubbard's "Insects Affecting the Orange," and investigations of the cause of the potato scab and potato rot.

Bees, C. V. Riley (pp. 350–360).—A popular article on various bees, both hive and wild. The general life history and habits of a hive of bees are treated of, and the more important special organs of bees, including the tongue, wax-producing organs, wax pincers, pollen hairs, and antennal comb are described and figured. The modifications in 3 wild species of the genus *Apis* and in other wild bees are mentioned and illustrated.

The San José or pernicious scale (pp. 360–369).—A somewhat popular review of *Aspidiotus perniciosus*, with an account of its presence in the East, where it is supposed to have been introduced on pears brought from California. It is believed that the pest can be stamped out by treatment with hydrocyanic gas.

Complete life history of the sugar-beet webworm, L. O. Howard (pp. 369–373).—Notes on the life history and ravages of *Loxostege sticticalis*, with description and figures of 2 of its parasites, *Cremnops vulgaris* and *Chelonus electus*. Arsenical mixtures are advised and winter harrowing of the land infested.

Notes from correspondence and general notes (pp. 373–379).—Among the topics treated are the following: Abundance of the peach-twig borer in Washington; grasshopper damage in Minnesota; a new Chrysomelid on apple in California; the army worm the present summer; coöperative work against insects; legal aspects of fumigation in California; notes from Illinois; another trial with English Hessian fly parasites; Provancher's Ichneumonidæ; cutworms and their hymenopterous enemies; bran and Paris green for cutworms; a leaf chafer attacking petunias; a severe conorhinus bite; kerosene emulsion as a deterrent against grasshoppers.

The minutes of 4 meetings of the Entomological Society of Washington are given, and an index to volume VI of Insect Life is appended.

Injurious insects in Hawaii, A. KOEBELE (*Rpt. Dept. Agr. and Forestry, Hawaiian Republic, 1894, pp. 98–104*).—Report of the entomologist, briefly reviewing the injurious insects found during a cursory survey of the islands. The most injurious species are as follows: *Rhizococcus* spp., affecting most of the trees and shrubs of the islands, but especially destructive to the citrus and coffee plantations, and probably introduced from Japan; *Pulvinaria psidi*, upon many trees and shrubs; the red scale of California; the purple scale of Florida; the pernicious or San José scale; several species of mealy bugs; and a snout beetle (an Otiorhynchid) which eats the leaves of many trees, plants, and shrubs. There are included lists of beneficial insects, chiefly Coccinellids, which have been introduced from California into the Hawaiian Islands.—L. O. HOWARD.

Insects in Ottawa in 1893, J. FLETCHER (*Canada Exptl. Farms, Rpt. 1893, pp. 157–183, figs. 26*).—Notes on various granary insects

and upon several species of insects attacking cereals, root crops, fodder crops, vegetables, orchard fruits, small fruits, forest trees, and live stock. The following are treated at greater length: Cutworms, red-legged locust (*Melanoplus femur-rubrum*), granary weevils, vegetarian carrion beetle (*Silpha bituberosa*), mottled umber moth (*Hibernia defoliaria*), black vine weevil (*Otiorhynchus sulcatus*), and horn fly (*Hæmatobia serrata*).

Locusts in New South Wales and the Fiji Islands (*Sugar Jour. and Trop. Cult.* [*Queensland*], *1894, Aug. 15, pp.* —).—An article on the migratory locusts, *à propos* to the damage which certain species have been doing in New South Wales and the Fiji Islands, particularly in cane plantations. The results of American and European investigations are carefully abstracted, with a special view to practical measures. Regarding the Fiji Islands occurrences, it is remarkable that the insects make their appearance most numerously after heavy rains rather than in seasons of drought, as is the case in this country.—L. O. HOWARD.

Experiments with feeding silkworms on mulberry leaves sprayed with Bordeaux mixture, N. PASSERINI (*Staz. Sper. Agr. Ital., 26* (*1894*), *No. 6, pp. 563–567*).—To determine the deleterious effect 300 healthy silkworms in the fourth stage were fed on mulberry leaves from a tree that the day previous to the beginning of the experiment had been sprayed with Bordeaux mixture. After the second day the worms began dying, and the mortality was so severe that but 1 larva passed into the chrysalis state. On analysis, copper in varying quantities was found in the bodies of the dead larvæ and about ½ mg. in the chrysalid. In a repetition of the experiment 13 caterpillars became chrysalids. Check larvæ fed as ordinarily suffered few deaths.

The use of lysol in treating plant parasites, SCHILLER (*Wiener ill. Gart. Ztg., 1894, 10, pp. 387–389*).—Account of successful use of the lysol in ¼, ½, and 1 per cent solutions for insects parasitic on various plants.

Notes on Conchylis ambiguella, and remedies against it, G. DEL GUERCIO (*Staz. Sper. Agr. Ital., 25* (*1893*), *No. 3 and 4, pp. 280–305*).—Notes on the "Tignuola," and an extended review of experiments in combating it with patent insecticides and emulsions of benzine, alcoholic solution of soap and water, and of kerosene and soapsuds, the last being preferred.

A kerosene attachment for knapsack pumps, H. E. WEED (*Mississippi Sta. Bul. 30, pp. 35–38, figs. 2*).—Description of an apparatus for mechanically mixing kerosene with water at the moment of applying the insecticide as a spray. The method is recommended as being simpler and more rapid than making a kerosene emulsion with soapsuds or milk, and the results appear to be equally successful.

Trials of spraying machines at Cambridge, C. WHITEHEAD (*Jour. Roy. Agl. Soc. England, ser. 3, 5* (*1894*), *No. 19, pp. 459–466, figs. 2*).—Notes on 3 horsepower and 13 hand spraying machines which

were tested in fields at Cambridge. Several of them are recommended as worthy of use, particularly one of the horsepower machines with nozzles so arranged near the ground as to spray the under surfaces of the leaves of low plants, such as potatoes, and thus destroy certain fungi which begin their attacks there.

The pulsometer in fruit culture, W. C. SMYTHE (*Gard. Chron., ser. 3, 16 (1894), p. 499, fig. 1*).—Description and figure of a steam watering and spraying apparatus. It is claimed that an orchard of 27 acres can be sprayed in 4 days, at a cost of £1 per day ($4.85), which includes cost of insecticide.

Beekeeping in Ontario, R. F. HOLTERMANN (*Ontario Agl. Col. and Exptl. Farm Rpt. 1893, pp. 232–235*).—A paper read before the Ontario Agricultural and Experimental Union, treating of the advantages and future of this branch of agriculture.

Salivary glands of bees, BORDAS (*Compt. Rend., 119 (1894), No. 17, pp. 693–695*).—Anatomical descriptions of the salivary glands in *Apis mellifica*, comparing them in the male and female.

Experiments with silkworm eggs, V. ROLLAT (*Compt. Rend., 119 (1894), No. 15, pp. 612–614*).—The eggs were kept in compressed air at different temperatures for various lengths of time from 3 to 48 hours, with the effect of diminishing the vitality.

Biological notes on Schizoneura peregrina, J. K. D'HERCULAIS (*Compt. Rend., 119 (1894), No. 20, pp. 863–866*).—Notes on this locust made during the invasions of 1891, 1892, and 1893 in Algeria. The feeding and breeding habits were investigated, and the observations are detailed.

The twentieth neotropical Aspidiotus, T. D. A. COCKERELL (*Actes Soc. Sci. Chile, 1894, pp. 35, 36*).—Description of *A. latastei*, a new species of pernicious scale.

The San José scale on Long Island, F. A. SIRRINE (*Garden and Forest, 7 (1894), p. 449*).—The author mentions finding this scale insect on pear, apple, peach, and quince stock in several nurseries.

Description of new Coccidæ, T. D. A. COCKERELL (*Ent. News, 1894, pp. 263, 264*).—Description of *Bergrothia steelii*, found on *Larrea*.

List of Coccidæ found on cacti, with description of a new species, T. D. A. COCKERELL (*Mem. Rev. Soc. Cientif., 7 (1893–'94), No. 11 and 12, pp. 461, 462*).—Ten species noted, *Mytilaspis philococcus* being described as new.

Dactylopius citri, life history and treatment, A. BERLESE (*Staz. Sper. Agr. Ital., 26 (1894), No. 1, pp. 48–56*).—It is believed that the pest is best reduced by encouraging its insect enemies.

The pear-tree psylla, M. V. SLINGERLAND (*New York Cornell Sta. Rpt. 1892, pp. 225–256, figs. 8*).—A reprint of Bulletin 44 of the station (E. S. R., 4, p. 472).

The pear borer, J. B. SMITH (*Garden and Forest, 7 (1894), p. 448*).—The author has determined the insect to be *Agrilus sinuatus* from Europe, instead of *A. acutipennis*, as doubtfully given in *Garden and Forest* for September 19, 1894.

Some observations on plant lice, M. V. SLINGERLAND (*Internat. Jour. Micr. and Nat. Sci., 4 (1894), ser. 3, pp. 414–420*).—Notes on successive generations with tables of results reprinted from *Science*.

New species of Ichneumon flies, G. V. BERTHOUMIEU (*Rev. Sci., 7 (1894), No. 82 and 83, pp. 178–189*).—Descriptions of 17 new European species.

FOODS—ANIMAL PRODUCTION.

Studies of dietaries, H. B. GIBSON and C. D. WOODS, Reported by W. O. ATWATER (*Connecticut Storrs Sta. Rpt. 1893, pp. 174–197*).—The work here reported is a continuation of that reported in the Annual

Report of the station for 1892 (E. S. R., 5, p. 594). The results of the study of 5 dietaries are given. A summary follows:

Results of dietary studies—Food eaten per man daily.

	Protein.	Fat.	Carbohydrates.	Fuel value.
	Grams.	*Grams.*	*Grams.*	*Calories.*
Mason's family	119	137	348	3,190
Carpenter's family	111	122	336	2,965
Station agriculturist's family, winter	99	139	398	3,335
Station agriculturist's family, summer	129	145	472	3,800
Students' club	92	141	346	3,110
Summary of 13 dietaries studied by station:[1]				
Minimum	83	103	336	2,965
Maximum	129	171	478	3,800
Average	105	140	405	3,395
Dietary standards for men at moderate work:				
Voit (German)	118	56	500	3,060
Atwater (American)	125	125	450	3,560

[1] Eight of these are reported in Connecticut Storrs Station Report 1892, p. 163 (E. S. R., 5, p. 594).

Compilation has been attempted at the station of all dietary studies on record. Records have been found of the examination of 491 dietaries, exclusive of army rations.

"The most of these have been made in Europe. The earliest dates back to 1851. The majority have been made during the past 15 years, and by far the larger number of the most reliable ones during the past 10 years. . . .

"My object in citing these statistics is to call attention to the fact that this kind of inquiry is to-day well under way in several parts of the world. It represents the beginning of a science, that of the comparative nutrition of mankind, the comparisons being made by race, class, occupation, income, and social condition."

Results of analyses of foods and feeding stuffs, C. D. WOODS (*Connecticut Storrs Sta. Rpt. 1893, pp. 17–27*).—Analyses of a number of samples of green fodder from oat grass, fescue grass, orchard grass, timothy, and cowpea vines; of corn silage, Hungarian grass hay, mixed hay, rowen hay, hay of timothy and redtop, oat hay, corn stover, corn meal, corn-and-cob meal, wheat bran, wheat middlings, linseed meal, cotton-seed meal, pea meal, gluten meal, hominy chop, malt sprouts, oat feed, rye bran, rye meal, sheep feed, and mixtures of corn and oats and of shorts and skim milk. These analyses are given for the natural water content and calculated to dry matter.

Composition of New England feeding stuffs, C. D. WOODS (*Connecticut Storrs Sta. Rpt. 1893, pp. 140–155*).—This is a summary of analyses of New-England grown feeding stuffs, compiled from analyses made at the station and elsewhere, and from the compilations given in Bulletin 11 of this Office. In case of each material the maximum, minimum, and average figures are given. "We have found these averages to differ considerably from the averages of all American analyses." This difference is illustrated by the following averages for Hungarian hay:

Composition of Hungarian hay.

	Water.	Protein.	Fat.	Nitrogen-free extract.	Fiber.	Ash.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Average of compilations by Jenkins and Winton.	7.7	7.5	2.1	49.0	27.7	6.0
Average of New England analyses	24.2	7.2	2.3	36.9	23.7	5.7

"These differences in composition were largely due to water content; but that they were not entirely due to the different percentages of water is shown by the composition calculated to water-free substance, as follows:"

	Protein.	Fat.	Nitrogen-free extract.	Fiber.	Ash.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Average of compilations by Jenkins and Winton	8.1	2.3	53.1	30.0	6.5
Average of New England analyses	9.6	3.0	48.8	31.1	7.5

The digestibility of feeding stuffs, C. D. Woods (*Connecticut Storrs Sta. Rpt. 1893, pp. 156–167*).—This is a compilation, and contains a translation of the summary of Dietrich and König's compilation of digestion coefficients, Jordan's compilation of American digestion experiments (E. S. R., 6, p. 5), and a summary of the average coefficients of digestibility given in the above two compilations.

Calculation of rations, C. D. Woods (*Connecticut Storrs Sta. Rpt. 1893, pp. 168–173*).—By means of the tables of composition and digestibility given above the calculation is made of the amounts of digestible nutrients in 1 lb. of different feeding stuffs, and the use of this data in the calculation of rations is explained.

Process for rendering foods and feeding stuffs more digestible, E. Maris (*English Patent; Jour. Soc. Chem. Ind., 13 (1894), No. 9, p. 898*).—The materials are submitted to a preparatory treatment by crushing and artificial digestion, or reproducing as nearly as possible the different phases of natural digestion. The ground material is put into digestion troughs with 3 or 4 times its weight of water and slightly acidulated with hydrochloric acid and sea salt, after which the necessary ferment (as pepsin, trypsin, invertin, amylase, and mineral ferment from grains, cereals, etc.) to the extent of 5 per cent is added, and the contents kept at a temperature of 35° C. for 12 hours. It is then transferred to a digester in which it is allowed to remain for 2 hours under steam pressure. The temperature is first raised to 65° C., and finally to 130° C. to destroy ferments and germs. The composition of a fodder made from wood by this process is as follows:

	Per cent.
Water	13.00
Albuminoid matter	8.74
Fats	2.62
Nitrogen-free extract	38.64
Ligneous matter	31.00
Ash	6.00
	100.00

Mangels and sugar beets vs. silage; yield, cost, and feeding value, H. J. WATERS and R. J. WELD (*Pennsylvania Sta. Bul. 26, pp. 19*).

Synopsis.—A comparison of the yields of total and digestible food materials per acre of mangel-wurzels, sugar beets, and green corn fodder; of the cost of growing these crops, and of feeding roots and silage to milch cows. The corn fodder furnished about one and one-half times as much dry matter as the roots, and considerable more digestible material. The cost of growing the roots was more than double that of the corn. In the feeding trial with 10 cows the lot fed silage produced more milk and butter than the other lot, the superiority being about 5 per cent. The silage lot made the larger gain in weight.

This experiment naturally divides itself into 2 parts—the growing of the crops and the feeding trial.

Growing the crops.—Eighteen twentieth-acre plats of fairly uniform land (upland clay limestone) were plowed and harrowed alike, and 200 lbs. of dried blood, 100 lbs. of muriate of potash, and 200 lbs. of dissolved South Carolina rock applied per acre. May 17 3 plats were planted to Breck Boston Market corn, 2 plats to Leaming corn in rows 3 ft. apart, with a kernel every 6 in., 7 were planted to Long Red mangel-wurzels, and 6 to Imperial sugar beets, in rows 32 in. apart, allowing a plant every 6 or 7 in. A good even stand was secured by thinning or by filling in vacancies.

"Shallow, level, and clean culture was given, and as much of it done with the horse hoe as possible to make the estimates of cost of cultivation more nearly comparable with field practice.

"The beets were hand-weeded twice, thinned and cultivated with the horse hoe 6 times. The corn was cultivated with the horse hoe 5 times."

The corn was cut for ensiling either when in milk or as it was passing out of the dough state. The yields and the composition of the crops are given, and from these the yield of food ingredients per acre is calculated as follows:

Yield of dry matter and its components per acre.

Crop.	Green substance.	Dry matter.	Ash.	Organic substance.			
				Protein.	Nitrogen-free extract.	Crude fiber.	Fat.
Corn:	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
Breck Boston Market	24,548	5,801	246.7	352.9	3,746	1,352.6	102.5
Leaming	12,635	5,243	173.4	293.2	3,760	850.0	166.2
Roots:							
Mangels	16,177	2,382	198.9	211.8	1,787	174.6	9.1
Sugar beets	11,436	2,010	203.3	177.3	1,491	129.6	7.4
Average of corn	18,591	5,522	210.0	323.0	3,753	1,101.3	134.3
Average of roots	13,806	2,196	201.1	194.5	1,639	152.1	8.2
Increase of corn over roots	4,785	3,326	8.9	128.5	2,114	949 2	126.1

"No attempt was made to produce large yields from any of the crops grown, but rather to compare the yields under good average conditions."

From the above data the following calculation is made of the yield of digestible materials:

Yield of digestible organic substance per acre.

Crop.	Dry organic matter.	Protein.	Carbohydrates.	Crude fiber.	Fat.
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
Corn:					
Breck Boston Market	3,761.8	208.2	2,510.0	973.9	69.7
Leaming	3,417.2	173.0	2,519.0	612.0	113.2
Roots:					
Mangels	1,873.5	158.2	1,631.5	74.7	9.1
Sugar beets	1,784.6	161.8	1,489.5	129.6	3.7
Average of corn	3,589.5	190.6	2,515.0	793.0	91.5
Average of roots	1,829.0	160.0	1,560.5	102.1	6.4
Increase of corn over roots	1,760.5	30.6	954.5	690.9	85.1

"The average product of the 2 varieties of corn and the 2 classes of roots shows a difference in digestible organic matter in favor of corn amounting to 1,760 lbs. per acre, or 96.2 per cent. The difference in green substance at time of harvest was 4,785 lbs., or 25.7 per cent. In dry matter the difference amounted to 3,326 lbs., or 151.4 per cent. In other words, as much digestible organic matter was produced on 1 acre when grown in corn as was obtained from 1.91 acres of mangels, or 2.05 acres of sugar beets."

Similar work at the Maine Station (Annual Report for 1891, p. 41; E. S. R., 4, p. 568) and at the Ontario Agricultural College (Bulletin 86; E. S. R., 4 p. 766) is cited. "In these trials the showing is much less favorable to corn than in our experiments, yet . . . neither of these stations is located in what may be regarded as the corn belt."

The estimated cost of growing the corn and roots, rating labor of man at 12½ cts., of man and horse at 17½ cts., and of man and double team at 25 cts., per hour, and including the cost of fertilizers but not the rent of the land, is $56.07 per acre for roots and $21.12 for the corn. "While these figures for an acre of corn may be regarded as entirely too high, it is believed that they are fairly comparable with those given for an acre of roots." The cost given by other stations for raising roots ranges all the way from $37.36 to $60.50 per acre.

Feeding trial.—Two lots of 5 cows each were fed during 3 periods of 12 days each, with a preliminary period of 10 days. In the first period both lots received the same ration of roots, silage, corn fodder, and grain. In the second period lot 1 had roots and lot 2 silage, the amount corresponding in both cases to the amount of dry matter given in the first period. In the third period both lots again had the same ration, of silage, corn fodder, and grain. The grain consisted at all times of a mixture of 54.5 parts of corn meal, 27.3 parts of wheat bran, and 18.2 parts of linseed meal. About 20 lbs. of silage or 35 lbs. of roots (mixture of mangel-wurzels and sugar beets) were fed daily per cow. The silage "was not of prime quality, owing to the development of too much acid."

The milk of each cow at each milking was weighed and in each period a 3-days' composite sample was taken for testing. The fat found was calculated to butter by adding one fifth.

The results of the trial are tabulated and the following summary given:

Summary of milk and butter produced.

	Period I.		Period II.		Period III.	
	Lot 1.	Lot 2.	Lot 1, roots.	Lot 2, silage.	Lot 1.	Lot 2.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Digestible matter eaten	837.60	832.20	945.80	813.20	1,373.20	1,375.80
Milk produced	1,256.60	1,156.90	1,299.20	1,072.80	1,328.10	1,170.50
Butter produced	54.10	56.47	61.88	58.61	62.66	62.49
Milk per 100 lbs. digestible matter	150.00	139.00	137.36	131.92	96.71	85.07
Butter per 100 lbs. digestible matter	6.46	6.79	6.53	7.21	4.56	4.54

"Lot 2 produced 5.1 per cent more butter per 100 lbs. of digestible matter consumed than lot 1 in period I, when all animals were fed alike on a ration of combined roots and silage; in period II, being fed the same amount of dry matter in the form of silage, and lot 1 an equal amount of dry matter in the form of roots, the difference in the butter produced per 100 lbs. of digestible matter was increased to 10.4 per cent. In other words, lot 1 should have produced in period II 6.86 lbs. of butter per 100 lbs. of digestible material consumed; when, as shown by the table, it only produced 6.53 lbs., showing a net gain in favor of silage of 5.0 per cent. . . .

"In periods I and III the amount of digestible nutrients consumed by each lot of cows was very nearly equal, but in period II, in which roots were fed against silage, there is a material difference, due mainly to the higher digestibility of the roots, but in a small part also, to the greater quantity of coarse fodder consumed in this period by the cows receiving roots. . . .

"In period II, when silage was fed against roots, every animal receiving a silage ration made a gain in live weight, while 4 of the 5 animals receiving the roots ration lost weight. The silage lot made a total gain of 90 lbs. and the roots lot lost 62 lbs., making a total difference of 152 lbs. in favor of silage. The loss sustained by the cows receiving roots was practically regained within the same number of days in the next period, when they were fed an equivalent amount of dry matter in silage."

Potatoes for stock feeding (*Jour.* [*British*] *Bd. Agr.*, *1* (*1894*), *No. 1*, *pp.* 25–28).—This is an abstract of a paper printed in French by M. Girard, describing an experiment in feeding potatoes to steers and sheep. In the case of both steers and sheep lot 1 received a normal ration of beets, lot 2 a normal ration of potatoes, and lot 3 a large ration of potatoes. The normal ration for steers was 110 lbs. of beets or 55 lbs. of cooked potatoes, with 11 lbs. of chopped straw, 16½ lbs. of hay and 10½ oz. of salt; and for sheep, 8.8 lbs. of beets or 4.4 lbs. of cooked potatoes, with 1.1 lbs. of chopped straw, 1.65 lbs. of hay, and 10½ oz. of salt. The large ration of potatoes was 66 lbs. for steers and 6.6 lbs. for sheep, the other fodder remaining unchanged. The feeding was continued a number of months. The steers and sheep on the potato rations made much larger gains than those on the beet rations, the gains being largest with the lots on the larger potato rations. The results with one lot of sheep fed raw potatoes were very inferior to those where cooked potatoes were fed.

The quality of meat produced on potatoes is reported as superior, the flavor being rich and delicate. In point of profit also the results were superior on the potato rations. The author is of opinion that the potato, when healthy and well developed, is to be regarded as an economical feed for meat production.

Feeding wheat to farm animals, F. D. COBURN (*Rpt. Kansas State Board of Agr. for quarter ending Sept. 30, 1894, pp. 15–188*).—To obtain information on the extent to which wheat was being fed in Kansas, the preferred methods of feeding it, the returns from feeding it, cost of wheat production, etc., a circular letter was sent to 1,000 wheat growers, stock raisers, feeders, dairymen, etc., in different parts of the State. The replies received from 400 of these form the basis of the report, although reports of trials in feeding wheat are also reprinted from bulletins of the experiment stations, from newspapers, etc. Following are some deductions from the replies received:

"Of the 24,827,523 bu. of spring and winter wheat raised in Kansas in 1893 there has been used as feed for animals 4,059,323 bu., or 16.4 per cent., Cowley and Sumner counties leading with 297,044 and 407,606 bu., respectively.

"When fed whole (perhaps more especially to hogs) 25 per cent of it passes the animals unmasticated and hence undigested and unassimilated—a shameful waste. The average of the estimates made by 81 correspondents in 20 counties is that above 30 per cent is voided without mastication; 12 correspondents, representing 5 counties, put it at 50 per cent or above, and a few others name a higher figure, while 10, reporting from 12 counties, average at 10 per cent.

"Three fourths of those reporting, representing 50 counties, state that, pound for pound, wheat is superior to corn for fattening hogs (even with one fourth unmasticated) by 7 to 35 per cent, the average of these indicating a superiority over corn of 16 per cent, while the average of the other one fourth of the reports, representing 26 counties, indicate that it was considered of less worth than corn by 12 per cent.

"To the question as to how much live pork may be expected as a fair return per bushel of wheat fed to hogs, the average of all the answers is 11 lbs., and the variation from 7 lbs., in a single instance, to as much as 20 lbs. in one other, but nearly all put their figures at or above 10 lbs. . . .

"Responses from 85 counties having all the wheat raised except 181,514 bu., received within the last 10 days of September, this year, to inquiries sent to 500 correspondents asking their estimates of the percentage of the wheat crop of 1894 which will be fed to farm animals, represent it as 30.4 per cent of the wheat in those counties; a total of 8,524,983 bu., or 110 per cent (4,465,660 bu.), more than the entire previous year's crop so used. . . .

"The average of all the reports as to the cost of wheat, raised and in the bin, including 7 per cent interest on the value of land upon which raised; also wear and tear of equipment, with different yields, shows thus:

Yield of 10 bu. per acre, 56½ cts. per bushel.
Yield of 15 bu. per acre, 48 cts. per bushel.
Yield of 20 bu. per acre, 35⅓ cts. per bushel.
Yield of 25 bu. per acre, 31 cts. per bushel.
Yield of 30 bu. per acre, 27 cts. per bushel.
Yield of 35 bu. per acre, 26 cts. per bushel.

"*A summary of conclusions.*—In a general way these reports show:

"In Kansas, under the conditions as to product and prices of wheat and corn existing in the years 1893–'95, wheat has become a very unusual and very important factor in the grain feeding of all classes of farm stock. It is superior to corn, pound for pound, as a grain to produce healthful, well-balanced growth in young ani-

mals. Mixed with corn, oats, or bran, it is much superior to either alone for working horses. Fed to cows, it is an exceptional milk producer, and for that purpose corn is scarcely to be compared with it.

"For swine of all ages, it is a healthful and agreeable food, giving generous returns in both framework and flesh, but fed whole, especially without soaking, is used at a disadvantage. Ground and made into slops it is invaluable for suckling sows, and for pigs both before and after weaning.

"For cattle, it has, at least as a part of their grain ration, a very high value, which is much enhanced in the line of needed variety by mixing with corn, and in a still greater degree by mixing judiciously with bran, oil cake, or other albuminous food tending to balance the too carbonaceous nature of the clear wheat.

"With corn and wheat approximating the same price per bushel it is not unprofitable nor wicked to feed the wheat; yet, if it can be ground, rolled, crushed, or in some way broken at a total cost not exceeding 5 to 7 cts. per bushel, to feed it whole and dry is unwise. It can be ground at a cost of 5 cts. per bushel, and on a majority of Kansas farms for very much less.

"If grinding is impracticable, soaking for 24 to 36 hours (the length of time depending somewhat upon the weather and season), is for various reasons deemed desirable, but is injudicious to any extent that its being moist facilitates swallowing without the mastication or the proper mixing with saliva. Any arrangement or system of feeding by which the grain was delivered in such a way that the animal could eat but slowly would largely overcome this defect.

"It is a superior food for all fowls, and as a promotor of the maximum egg-production is unsurpassed by any other grain."

The fattening of cattle, J. W. ROBERTSON (*Canada Exptl. Farms Rpt. 1893, pp. 64–71*).—An experiment with steers begun in 1889 and continued for 3 years. Part of the data has been given (E. S. R., 4, p. 440). The object was to compare (1) silage, hay, and roots; (2) hay and roots; and (3) silage when fed with a constant grain ration.

The conclusions from the 3 years' test are:

"(1) On an average the steers which were fed on corn silage, straw, and meal gained in weight 35.8 lbs. more per head and cost 5.38 cts. less per head per day for feed consumed than the steers which were fed upon hay, roots, straw, and meal.

"(2) On the average of 2 years the cost for feed consumed for 100 lbs. of increase in live weight was 64.64 per cent greater on hay, roots, straw, and meal than it was on corn silage, straw, and meal."

In a trial with 1 and 2-year-old steers fed 20 lbs. of cut hay, 40 lbs. of roots (mangel-wurzels, turnips, and carrots), and 5 lbs. of straw, or 50 lbs. of corn silage and 5 lbs. of cut straw, with a constant grain ration of equal parts of barley, peas, and frosted wheat, the result was as follows:

"(1) During the feeding period of 24 weeks the steers which were fed upon corn silage, straw, and meal gained in weight on the average 19 lbs. per head more and cost 5.06 cts. per head less per day for feed consumed than the steers which were fed upon hay, roots, straw, and meal.

"(2) The cost for feed consumed per 100 lbs. of increase in live weight was 66.34 per cent greater on hay, roots, straw, and meal than it was on corn silage, straw, and meal."

A similar trial with calf steers resulted as follows:

"(1) During the feeding period of 18 weeks the steers which were fed upon corn silage, straw, and meal gained in weight on the average 16 lbs. per head less and

cost 2.87 cts. per head less per day for food consumed than the steers which were fed upon hay, roots, straw, and meal.

"(2) The cost of feed consumed per 100 lbs. of increase in live weight was 27.6 per cent greater on hay, roots, straw, and meal than it was on corn silage, straw, and meal.

"(3) The cost of feed consumed per 100 lbs. of increase in weight was lowest in the case of a calf steer of 'French Canadian' or 'Quebec Jersey' breed fed upon corn silage, straw, and meal."

Two grade Shorthorn heifers were fed a ration of hay, roots, and straw, and 1 grade Shorthorn, and 1 Holstein heifer a ration of corn silage, and straw for 24 weeks, with 4 or 5 lbs. of the grain mixture (barley, peas, and frosted wheat) per day. The following is the result secured:

"(1) During the feeding period of 24 weeks the animals which were fed upon corn silage, straw, and meal gained in weight on the average 63 lbs. per head more and cost 4.72 cts. per head less per day for feed consumed than the animals which were fed upon hay, roots, straw, and meal.

"(2) The cost for feed consumed per 100 lbs. of increase in live weight was 94.82 per cent greater on hay, roots, straw, and meal than it was on corn silage, straw, and meal."

Summarizing all the results obtained in the experiments in this line the conclusions are that:

"(1) During the feeding period of 24 weeks the animals which were fed upon corn silage, straw, and meal gained in weight on the average 51 lbs. per head more and cost 4.61 cts. per head less per day for feed consumed than the animals which were fed upon hay, roots, straw, and meal.

"(2) The cost for feed consumed per 100 lbs. of increase in live weight was 92.08 per cent greater on hay, roots, straw, and meal than it was on corn silage, straw, and meal.

"(3) The cost of feed consumed per 100 lbs. of increase in weight was lowest in the case of a grade Shorthorn heifer (viz, $5.44 per 100 lbs. of increase in weight) fed upon corn silage, straw, and meal."

Corn silage and straw for making beef, C. A. ZAVITZ (*Ontario Agl. Col. and Exptl. Farm Rpt. 1893, pp. 118–121*).—Six Shorthorn grade steers, 5 two-year-olds, and 1 yearling, were fed during 3 periods of 60 days each, December 1 to May 30, a mixture of equal parts by weight of oats, barley, and peas, all ground, corn silage, and oat straw or hay. The amounts of coarse fodder were very nearly the same in all the periods. The amount of grain per head was daily increased from 3.2 lbs. in the first period to 8.5 lbs. in the last period. The grain and coarse fodder were intimately mixed before feeding.

The average gain in weight per head was 124.33 lbs. in the first period, 105.33 lbs. in the second period, and 93.66 lbs. in the third period, the average gain per day for the same time being 207, 176, and 156 lbs., respectively. Estimating the oats at 24.5 cts., barley at 38 cts., and peas at 57 cts. per bushel, cut straw at $2, cut hay at $6.50, and corn silage at $1.75 per ton, the average cost of the daily ration was 6.41 cts. for the first period, 9.35 cts. for the second period, and 12.31 cts. for the third period. The average cost of food per pound of

gain was 3.09 cts. in the first period, 5.31 cts. in the second period, and 7.89 cts. in the third period. The steers were bought at 3.25 cts. per pound and sold at 5.25 cts. per pound live weight. Estimating the value of the manure at $1.50 per ton, and making allowance for the cost of attendance, a profit of $142.55 is figured out.

Corn meal and grass with stock steers, D. A. KENT (*Iowa Sta. Bul. 25, pp. 41–43*).—Fourteen steers, 6 2-year-olds and 8 yearlings (12 Holsteins and 2 Jerseys), were divided into 2 equal lots, pastured in similar pastures from May 22 to September 9 (111 days). Lot 1 received 15 lbs. of corn meal per day and per head, and lot 2 received no grain. The pasture was in good condition, and consisted chiefly of clover, with a good sprinkling of timothy and blue grass. Each lot was allowed 7 acres of pasturage. The weights of the individuals at different dates during the season are tabulated.

"During the entire period of 111 days the meal-fed steers consumed 11,655 lbs. of meal, and made a net gain over the grassers of only 273 lbs. Rating the meal at 75 cts. per cwt., the 273 lbs. of net gain cost 32 cts. per pound. The meal was a total waste in the first period of 34 days, while in the other periods the net gain was so small as to be unprofitable. . . .

"The hair of the meal-fed steers seemed to have a better luster than the grassers. After the grass experiment closed both lots of steers were fed on full feed until the 29th day of the following April, a period of 238 days. During this period the lot that had been fed meal during the pasture period showed a gain of 113 lbs. over the grassers."

Feeding steers with frozen wheat and barley, S. A. BEDFORD (*Canada Exptl. Farms Rpt. 1893, pp. 255, 256*).—This is similar to an experiment reported the previous year (E. S. R., 5, p. 631). Nine grade Shorthorn steers about 2½ years old were divided into 3 even lots and fed for 5 months all they would eat of the following rations:

Lot 1, 20 lbs. cut wheat straw and 1.5 lbs. cracked frozen wheat.

Lot 2, 15 lbs. cut wheat straw, 9 lbs. cracked frozen wheat, and 20 lbs. sliced turnips.

Lot 3, 10 lbs. cut wheat straw, 10 lbs. cracked barley, and 20 lbs. sliced turnips.

The feed in the above proportions was mixed and moistened before feeding.

The steers were bought at 2½ cts. per lb. and sold at 3½ cts. The average daily gain per steer was 1 lb. 4 oz. for lot 1, 1 lb. 3 oz. for lot 2, and 1 lb. 13 oz. for lot 3.

"Last year's return from the frozen wheat fed to group 1 was equal to 56 cts. per bushel, this year it equals 60 cts.

"Deducting the value of turnips, the frozen wheat fed to group 2 realized last year 61 cts. per bushel, this year 68 cts.

"The wheat fed was the same both years, but the steers were much quieter last winter and for that reason better feeders.

"No. 3 frozen wheat sold at an average of 30 cts. per bushel in the winter of 1891–'92 and about 25 cts. last winter.

"After deducting the value of turnips [at 5 cts. per bushel], the barley fed to group 3 realized 42 cents per bushel."

Test of feeding dry cows, A. MACKAY (*Canada Exptl. Farms Rpt. 1893, pp. 306, 307*).—A comparison made on 4 grade cows of oats and barley fodder made into hay and the same made into silage "seems to show that cattle gain more on [oat and barley] silage and meal than on [oat and barley] hay, meal, and roots; and that the cost of silage and meal is less than of hay, meal, and roots."

Calf feeding, C. F. CURTIS (*Iowa Sta. Bul. 25, pp. 17–25*).

Synopsis.—A comparison on 6 calves of feeding linseed meal, oatmeal, and a mixture of corn meal and ground flaxseed with separator skim milk. The gain on the linseed meal was slightly less than on the other two feeds, and the cost more.

This is a repetition of an experiment reported in Bulletin 19 of the station (E. S. R., 4, p. 739). Six high-grade Shorthorn calves from 1 to 2 weeks old were divided into 3 lots and fed the following rations from September 26 to December 24—90 days:

Lot 1, skim milk and new-process linseed meal.
Lot 2, skim milk and oatmeal.
Lot 3, skim milk and 1 part ground flaxseed to 9 of corn meal.

At the beginning of the experiment each calf received 15 lbs. of milk and $\frac{1}{4}$ lb. of grain per day, which was increased gradually until at the close 18 lbs. of milk and $1\frac{1}{4}$ lbs. of grain per day were given. The skim milk was from a separator and contained only a trace of fat. It was fed warm. Hay was given to all the calves alike. The oatmeal was ground fine and separated from the hulls. Approximately like amounts of food were eaten by each lot. The main results are tabulated below:

Summary of results of calf feeding.

	Gain in live weight.			Nutritive ratio of food.	Cost of food per lb. of gain.
	Calf No. 1.	Calf No. 2.	Total.		
	Pounds.	*Pounds.*	*Pounds.*		*Cents.*
Lot 1 (linseed meal)	144	$131\frac{1}{3}$	$275\frac{1}{3}$	1:2.7	2.1
Lot 2 (oatmeal)	$153\frac{2}{3}$	$147\frac{1}{3}$	301	1:3	1.9
Lot 3 (corn meal and flaxseed meal)	$148\frac{2}{3}$	$132\frac{1}{3}$	281	1:3 1	1.9

The cost of the food is based on linseed meal and oatmeal at $1\frac{1}{4}$ cts., cornmeal at $\frac{1}{2}$ ct., ground flaxseed at 1 ct. per pound, separator skim milk at 15 cts. per cwt., and hay at $5 per ton. On an average the calves made a pound of gain for every 1.97 lbs. of dry matter eaten. When the calves were 8 months old they averaged a pound of gain for 4.6 lbs. of dry matter.

"The conclusion seems warranted that a nitrogenous feed, such as oil meal, is neither necessary nor most profitable to supplement a separator-milk ration for young calves. All of these rations, even when corn and flaxseed were used, were narrower than whole milk, and it is evident that the element lacking in separator milk is not albuminoids, but fat or its equivalent—carbohydrates—in some form palatable and digestible to calves."

Investigations of breeds of dairy cows, R. GRIPENBERG (*Mustiala Agl. College Rpt. 1892, pp. 30–49*).—*Milk from Holstein, Ayrshire, Angler, and native cows during 1889–'91.*—The quantity of milk

produced by the cows in the Mustiala College herd has been ascertained since 1885, and also the food eaten by the cattle. The cream content of each cow's milk was determined during 1889–'91, inclusive, once a week by means of Fjord's control centrifuge. The average percentages of cream[1] for the various breeds for the 3 years are given in the following table. The author compares the relative economy of the different breeds on the basis of units of concentrated feed consumed (3 lbs. of hay considered equal to 1 lb. of concentrated feed). The average data for the various breeds during 1885–'89 is as follows:

Cream in milk of different breeds.

Breed.	Yield of milk per year.	Cream content. 1889.	Cream content. 1890.	Cream content. 1891.	Average 1889–'91. Cream.	Average 1889–'91. Fat equivalent.*a*	Concentrated feed per 100 lbs of milk.
	Pounds.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Units*
Holstein	7,939	5.06	4.87	4.79	4.91	2.9	About 32
Ayrshire	5,881	6.34	5.83	5.91	6.03	3.6	About 37
Angler	6,111	5.32	5.17	5.05	5.18	3.1	About 35
Native	4,375	6.21	5.64	5.60	5.81	3.4	About 45

a Approximate.

The food consumed during the 3 years mentioned, as well as the milk produced by the various breeds, is given in the following summary:

Summary of food consumed per year per head and products obtained 1889–'91.

Breed.	Average number of cows.	Approximate quantities of hay eaten.	Concentrated feeds.	Milk produced per year.	Concentrated feeds per 100 lbs. of milk.	Concentrated feeds per pound of fat
		Pounds.	*Pounds.*	*Pounds.*	*Units.*	*Units.*
Holstein	13	3,530	1,305	6,513	38	7.7
Ayrshire	27	3,248	1,021	5,125	41	6.8
Angler	8	3,178	1,023	5,035	41	8.1
Native	4	2,826	883	4,093	45	8.4

The fat content of milk from Holstein cows.—The determinations were made weekly during 1889–'91, by means of a lactocrite, and an account kept of the quantity of milk produced and the food consumed. The average percentage of fat in the milk of all the Holstein cows during 1889–'91, arranged by months, was as follows: January, 3.09; February, 2.94; March, 2.79; April, 2.89; May, 2.98; June, 3.49; July, 3.53; August, 3.65; September, 3.45; October, 3.23; November, 3.10; and December, 3.04. The average fat content of the milk from the individual cows during these years varied from 2.69 to 3.79 per cent; the annual milk production varied from 4,216 to 7,977 lbs.; the production of fat from 127.9 to 254 lbs.; and the number of units of concentrated feed from 887 to 1,302.

[1] One per cent of cream, as found by Fjord's test, corresponds very nearly to 0.6 per cent fat.

Arranging the results of the fat determinations made in the milk from the individual cows according to the time of calving, whether in the fall or spring, and in both cases for each successive month of the lactation period, the results show that the lowest fat content of the milk, as a rule, both for fall and for spring calving cows, came during the second or the third month of the period of lactation. There is a gradual increase toward the end of the period in both cases, as will be seen from the average results given below:

Average per cent of fat in cows' milk in different months of lactation.

Number of cows included.	Month of lactation period.											
	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.
Cows calving in spring:												
8	3.0	2.8	2.8	2.9	3.4	3.6	3.7	3.6	3.9	3.8	4.2	4.4
5	2.7	2.4	2.5	3.3	3.5	2.9	2.9	2.9	3.3	3.4	3.9	.....
3	2.9	2.5	2.7	2.7	3.0	3.1	3.0	3.0	3.2	3.9	5.0	.....
Cows calving in fall:												
8	3.4	3.1	2.8	2.8	2.7	2.8	2.9	3.3	3.5	3.7	3.5	3.9
9	3.1	2.5	2.7	2.7	2.9	3.0	3.2	3.7	3.6	3.9	3.8	.....

Comparative determinations of the fat content of samples of milk by the lactocrite and the gravimetric or Soxhlet's aërometric methods made incidentally gave on an average of 26 analyses: Lactocrite, 3.02 per cent; results divided by 1.03, as directed, 2.94 per cent; gravimetric or Soxhlet's methods, 2.94 per cent.—F. W. WOLL.

On the importance of fat determinations as an accessory in the improvement of dairy cattle, A. LA COUR (*Tidskr. f. Landökon., 13 (1894), pp. 303–336*).—The paper discusses the various means at our disposal for developing the productive capacity of milch cows, and especially the question of the hereditary transmission of good milking qualities from one generation to another, both yield and composition being considered.

The cause of the enormous increase in the production of butter in Denmark during late years, according to the author, lies in the improved system of feeding and the better treatment of the cows on the small dairy farms. The best herds at the large Danish estates yield on an average 5,500 to 6,600 lbs. of milk per head annually, and only exceptionally reach the latter figure, while the average yields at the best smaller farms are from 1,650 to 2,200 lbs. higher. The conditions of the smaller dairy farms are more favorable for the improvement of the herd than those of the larger ones.

As a first attempt of a study in this line the author investigated the yield and quality of the milk of 104 cows at the estate of Näsgaard for 5 consecutive years, beginning in the fall of 1888. The milk from each cow was weighed and sampled once a week, separate samples being taken of the evening and the morning milkings, and the percentage of

cream determined by Fjord's control centrifuge. In this way 70 to 90 examinations of the milk of each cow were made annually, and from these figures the yearly averages were calculated. During the last 2 years the determinations were excluded which were made directly after calving or toward the end of the lactation period, when the yield fell below 8.8 lbs. a day. The averages for the whole herd from 1888-'93, inclusive, were 5.3, 5.5, 5.5, 4.8, and 4.9 per cent of cream,[1] respectively. The author states that there is no reason to believe that the milk had become thinner during the last 2 years, but the decrease must be due to the difference in the method of procedure.

The average per cent of cream in the milk of individual cows during the different years varies less than might be expected. For 75 per cent of the cows the variations are within 0.5 per cent of cream (about 0.3 per cent fat), the extreme variation of 1.2 per cent (0.7 per cent fat) occurring with only 3 cows.

The influence of the age of cows upon the quality of milk is indicated by the results summarized in the following table, which is based on the averages of 5 years' observation:

Relation of age of cows to composition of milk.

Age of cows.	Number of cows.	Cream above or below herd average.	Age of cows.	Number of cows.	Cream below herd average.
Years.		*Per cent.*	*Years.*		*Per cent.*
2	84	+0.1	10	20	0.2
3	76	+0.1	11	13	0.1
4	57	+0.1	12	10	0.3
5	46	0.0	13	8	0.3
6	41	0.0	14	6	0.6
7	23	—0.1	15	1	0.6
8	20	—0.1	16	1	0.9
9	14	—0.1	17	1	0.5
....	....	....	18	1	0.4

The average effect of the quantity of milk given on the quality is shown below:

Relation of yield of milk to composition.

Annual yield of milk.	Number of cows.	Cream above or below herd average.
Pounds.a		*Per cent.*
13,000 to 14,000	2	—0.4
10,000 to 11,000	1	+0.6
9,000 to 10,000	11	—0.1
8,000 to 9,000	26	—0.1
7,000 to 8,000	44	—0.1
6,000 to 7,000	80	—0.2
5,000 to 6,000	93	0.0
4,000 to 5,000	97	+0.2
Under 4,000	67	+0.1

a Danish pound (1.1 lb. avoirdupois).

The results seem to warrant the conclusion that younger animals give somewhat richer milk than older ones, and that cows at the age of

[1] One per cent of cream as found by the control centrifuge corresponds to 0.59 to 0.64 per cent, or about 0.6 per cent of butter fat.

5 to 6 years yield milk of average quality. The author, however, does not believe that results found with individual cows bear out this conclusion, and states that investigations of the records at the coöperative creamery at Kildebrönde (Denmark) also fail to show any relation between the yield of milk and its quality in case of single cows or whole herds.

The value of the successive generations for dairy purposes was carefully studied from the data obtained, and the main results are embodied in several tables in the original paper. The hereditary tendencies as regards the fat content of the milk, in the author's opinion, seem less pronounced than those relating to a large flow of milk. It is instructive to note that the cows which transmitted the milking qualities with the greatest certainty were also ahead as regards the transmission of richness of milk.

The requisites, according to the author, for the improvement of herds of milch cows are excellence as regards (1) yield of milk, (2) quality of milk, (3) external appearance, (4) pedigree. He proposes to give each of these groups 4 points, and to express the value of a cow for breeding purposes by summarizing the scorings on these several points. The total score is to be copied in the record book, so as to indicate at a glance the position of the cow in the herd. Only bulls whose dams produced rich milk are to be used for the renewal of the herd.—F. W. WOLL.

Breed tests of dairy cows, G. GROTENFELT (*Mustiala Agl. College Rpt. 1892, pp. 39–48*).—The dairy herd of the agricultural college at Mustiala (Finland) includes the following breeds and crosses: Ayrshire, Holstein, Ayrshire-Holstein, Angler, Ayrshire-Angler, Ayrshire-Allgauer-Finnish, Ayrshire-Finnish, and natives. The average annual yield of milk of each breed, the average live weight, and the milk produced per 1,000 lbs. live weight are shown in the following table:

Milk yield of breeds during 1892.

Breed.	Number of cows.	Average milk yield per head.	Average live weight.	Milk produced per 1,000 lbs. live weight.
		Pounds.	*Pounds.*	*Pounds.*
Ayrshire	22	5,598	996.4	5,616
Holstein	10	7,386	1,203.2	6,095
Angler	6	4,857	970.0	5,006
Ayrshire-Finnish	2	5,598	921.6	6,073
Ayrshire-Allgauer-Finnish	2	5,165	978.8	5,276
Ayrshire-Holstein	6	6,876	1,119.6	6,145
Ayrshire-Angler	3	5,534	1,042.6	5,308
Natives	9	4,445	(840.2)	(5,290)
Total	....	5,759	[1] 1,047	5,501

[1] Natives not included.

The cows were divided into 5 classes as regards the amounts of concentrated feeds given. Class 1 received 6.6 to 8.4 lbs.; class 2 about 5.5 lbs.; class 3 about 4.4 lbs.; class 4 about 2.2 lbs., and class 5 (dry cows)

1.1 lbs. All cows received per head per day from 17.6 to 6.6 lbs. of hay and straw from spring cereals *ad libitum*.—F. W. WOLL.

A study of rations fed to milch cows on sixteen dairy farms in Connecticut, C. D. WOODS and C. S. PHELPS (*Connecticut Storrs Sta. Rpt. 1893, pp. 69–115*).—The observations here reported were made during the winter of 1892–'93. The herds to be tested were selected after a personal inspection or considerable correspondence. A station assistant remained at each farm during the test, weighing the feed eaten and the milk produced by each cow, taking samples of the feeding stuffs for analysis, testing the composite samples of the milk of each cow, and making a record of the breed, weight, and stage of the milking period. Any uneaten food was weighed back and allowance made. With two exceptions the tests lasted 5 days each. The feeding stuffs were all analyzed at the station. The 16 herds tested contained 254 milking cows, the smallest containing 10 and the largest 20 cows. Three fourths of this number were either pure or grade Jerseys or Guernseys. The majority of the cows were between 3 and 6 months advanced in the milking period.

Detailed and summarized statements are given for each herd of the age, weight, and milk yield of each cow; the percentage of fat and the total amount of fat in the milk for 5 days; the amount of food given and total and digestible nutrients in the daily rations of coarse fodder and grain. The average of the 16 rations was as follows:

Average composition of the rations for dairy cows.

	Digestible protein.	Digestible fat.	Digestible carbohydrates.	Nutritive ratio.	Fuel value.
	Pounds.	*Pounds.*	*Pounds.*		*Calories.*
Concentrated food	1.58	0.58	4.47		13,700
Coarse food	0.90	0.36	9.62		21,100
Total	2.48	0.94	14.09	1:6.5	34,800

In the 16 rations the digestible protein ranges from 1.35 to 3.16 lbs., the nutritive ratio from 1:4.5 to 1:11.3, and the fuel value from 28,750 to 42,600 calories. The authors believe that the cows of the herds examined and the method of feeding were both rather better than the average for the State.

In another summary the yields of butter fat during the 5 days are classified in accordance with the nutritive ratios of the rations and the amounts of digestible protein which they contain. In this all cows under 2 years old and all which had been giving milk more than 8 months were omitted, as also, in one or two instances, animals giving unusually small yields. The summary follows:

Summary of rations fed and yields of butter fat obtained from 16 herds examined.

Herd No.—	Summary of rations fed.				Average yields of butter fat per cow in 5 days.			
					Nutritive ratio.		Digestible protein.	
	Total organic matter.	Digestible protein.[1]	Nutritive ratio.[2]	Fuel value of digestible nutrients.	Greater than 1:6.	Less than 1:6.	More than 2.3 lbs.	Less than 2.2 lbs.
	Lbs.	*Lbs.*	*1:*	*Calories.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1	25.4	2.50	6.0	33,450		4.6	4.6	
2	27.2	2.80	6.0	37,000		4.2	4.2	
3	26.9	3.00	5.5	37,950		5.3	5.3	
4	31.2	2.60	7.0	39,800	3.5		3.5	
5	29.6	3.15	5.5	39,400		4.1	4.1	
6	26.6	2.05	8.0	34,500	3.7			3.7
7	32.0	2.45	8.5	42,600	4.6		4.6	
8	33.7	3.15	6.0	41,350		4.3	4.3	
9	22.8	2.15	6.5	29,950	3.8			3.8
10	24.4	2.30	6.5	32,100	[3]5.0		5.0	
11	26.4	2.75	5.5	34,450		4.0	4.0	
12	23.4	3.00	4.5	30,750		5.5	5.5	
13	20.5	2.20	6.0	28,750		3.6		3.6
14	26.2	2.65	6.0	33,750		4.7	4.7	
15	23.8	1.35	11.5	30,900	3.3			3.3
16	22.8	1.45	9.5	29,600	3.8			3.8
Average	26.4	2.50	6.5	34,800	3.9	4.5	4.5	3.6

[1] As here tabulated the weights of protein are given to the nearest 0.05 of a pound; thus, 2.51 lbs. is called 2.50, etc.
[2] As here tabulated the nutritive ratios are taken to the nearest 0.5; thus, 6.2 is called 6; 6.4 is called 6.5, etc.
[3] Cows nearly all new milch. Nutritive ratio, 1:6.4.

"The animals having the narrower ration produced on the average 0.6 lb. more of butter fat in 5 days than did those having the wider. . . .

"The animals having the larger amounts of protein gave on the average 0.9 lb. more of butter fat in 5 days than did those having the smaller quantities of protein.

"With the exception of the animals of herd 10 those which are classified as receiving more than 2.3 lbs. of digestible protein were all actually receiving about 2.5 or more pounds of digestible protein per day. The animals of herd 10 were all practically new milch . . . [which] would seem to account, in part, at least, for the high yield of butter fat.

"The largest butter-fat yields, with the exception of that from herd 10, were from herds 12, 3, 14, and 1. The rations fed these herds contained, respectively, 2.99, 3.01, 2.66, and 2.51 lbs. of digestible protein. Their nutritive ratios were as follows: 1:4.5, 1:5.7, 1:5.8, 1:6.2. Their fuel values were 30,750, 37,950, 33,750, and 33,450 calories. Too much importance should not be attached to these results, as they may have been partly accidental and due to causes other than feed. It is, nevertheless, a noteworthy fact that in the cases in which the cows were in about the same period of lactation the yields of butter fat decreased as the protein decreased and as the nutritive ratio increased. The largest yield was from a herd receiving a very narrow ration (1:4.5) and one which contained a large amount (about 3 lbs.) of digestible protein. . . .

"The rations which seem to have given the best returns contained more protein than Wolff's standard calls for. From the fact that the best butter-fat yields were obtained from a ration containing less than 31,000 calories of potential energy, it seems fair to assume that those which contained upward of 40,000 were quite excessive.

"The evidence at present at our command would seem to indicate that the quantity of digestible protein called for by the German (Wolff's) standard is none too large, and that it would be safe in the general run of cases to feed as much or even more protein if we would obtain the largest yields of butter fat from our milch

cows. It would also perhaps be wiser, until we have more light than we have at present upon this matter, to make our rations larger, so far as their total energy is concerned, than those of the German standard. The size of the ration suggested by the Wisconsin Station [E. S. R., 5, p. 884] as a standard ration may, when it is measured by its fuel value, not be too large for the demands of our conditions. Feeding stuffs rich in carbonaceous foods (fats and carborhydrates) are abundant and cheap with us, and it is difficult to utilize the foods ordinarily produced on the farm without making our rations larger in total energy than the German standard calls for."

These considerations lead the authors to suggest tentatively the following ration for cows per 1,000 lbs. live weight: Organic matter 25 lbs., digestible protein 2.5 lbs., digestible fat 0.5 to 0.8 lb., digestible carbohydrates 13 to 12 lbs., fuel value 31,000 calories, nutritive ratio 1:5.6. This contains the same amount of protein as Wolff's standard, but rather more fat or carbohydrates, furnishing 1,400 calories more.

In conclusion, the 16 rations are discussed individually and changes suggested in each case, usually cheapening the ration. The educational value of such tests is likened to that of coöperative field experiments with farmers.

Feeding winter dairy cows, J. WILSON (*Iowa Sta. Bul. 25, pp. 3–16*).

Synopsis.—A trial of feeding cabbage, mangel-wurzels, turnips, corn fodder, and silage to 20 cows. The butter produced when corn fodder or mangel-wurzels were fed scored the highest, and that when cabbage was fed the lowest. The latter did not keep well. When turnips were fed the butter scored a little higher, but was colorless.

Twenty cows were fed for 97 days to test the effect, in separate periods, of cabbage, mangel-wurzels, turnips, corn fodder, and silage on the milk and butter. Of the first three materials about 30 lbs. was fed per cow daily, in connection with a basal ration of 12 lbs. of corn meal, 5 lbs. of bran, and 20 lbs. of hay.[1] When corn fodder and silage were fed the corn meal was reduced to about 3 lbs. and the bran increased to 7.5 lbs. per head. It is not stated whether the hay was continued unchanged, and no mention is made of the amount of corn fodder or silage given further than that "the corn fodder and corn meal had the equivalent of the corn meal fed during the previous periods." Ten of the cows had been giving milk, on an average, 209 days at the beginning of the trial, and 2 were replaced during the trial by fresh cows. The separate periods lasted from 2 to 3 weeks, and the changes of food were gradual. The 20 cows gained 2,000 lbs. in weight during the trial.

Composite samples were taken of the milk, which were tested for fat. The results of these tests, the yield of milk, and scoring and analyses of the butter are tabulated for each period, together with the analyses of the cabbage, mangel-wurzels, and turnips. Some conclusions as to the effect of the different coarse fodders on the yield and composition of the

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[1]This basal ration would furnish per cow approximately 31.4 lbs. of dry matter, 2.12 lbs. of digestible protein, 19.2 lbs. of digestible carbohydrates, and 0.77 lb. of digestible fat, with 42,900 calories of heat and a nutritive ratio of 1:9.87. The ratio would be little, if at all, improved by the addition of more coarse fodder in the form of cabbages, turnips, or mangel-wurzels.—Ed.

milk are given in the bulletin. It is difficult, however, to see how under the conditions of this experiment the data obtained can furnish any reliable indications on these points. The scoring of the butter on the basis of 45 points was as follows: Cabbage period 38, mangel-wurzel period 43, turnip period 40, corn fodder period 43, and silage period 40.

"The creamery experts report that the butter from the cabbage ration did not keep well, but gradually became tainted. . . .

"Butter from the turnips scored 40; it was colorless. The cows were fed after milking to avoid the effects of the roots as much as that would enable them to do so. . .

"The high quality of mangel butter, scoring equal to that from corn fodder, with the other good qualities of the vegetable, commends it to the dairymen of Iowa."

The estimated cost of food per pound of butter ranged from 9.6 cts. in the corn fodder period to 11 cts. in the mangel-wurzel period, but the prices of feeding stuffs used in this calculation are not given.

At the conclusion of the trial 4 cows were fed ruta-bagas. The butter produced scored 40 points.

Effect of food on the per cent of fat in milk, H. H. DEAN (*Ontario Agl. Col. and Exptl. Farm Rpt. 1893, pp. 148–150*).—A comparison of pasturage, with and without grain, with barn feeding. Fifteen milch cows, which had been receiving a ration of 1 bu. of roots, 20 lbs. of hay, 4 lbs. of bran, and 4 lbs. of ground wheat in the barn, were turned out to pasture May 29, and divided into 2 lots. For the first 4 weeks lot 1 (8 cows) received pasturage, with only 1 lb. of bran per day, and lot 2 (7 cows) received a grain ration—equal parts of peas, bran, and wheat, 1 lb. of each at first, which was increased to 3 lbs. During the second 4 weeks lot 1 received the grain ration of lot 2, and lot 2 received equal parts of bran, cotton-seed meal, and linseed cake, increasing from 1 lb. to 3 lbs. of each. For 2 weeks following this lot 1 had pasturage and green peas and oats, and lot 2 was continued on the same grain ration. The results of tests of composite samples of the milk of each cow are tabulated. The percentage of fat invariably increased when lot 1 (no grain) was turned to pasture, and in the case of lot 2 increased with 4 cows and decreased with 3 cows, which brought down the average. The average results by lots are as follows:

Composition and yield of milk on barn feeding and pasturage.

Period.		Average fat content of milk	Yield of milk per week.	Yield of fat per week.
	Lot 1:	*Per cent.*	*Pounds.*	*Pounds.*
	Barn feeding	3.51	1,308	45.9
1	Pasturage and 1 lb. of bran	3.96	1,355	54.7
2	Pasturage and bran, peas, and wheat	3.83		
3	Pasturage and green peas, and oats	4.00		
	Lot 2:			
	Barn feeding	3.32	1,466	48.9
1	Pasturage and bran, peas, and wheat	3.33	1,896	62.0
2	Pasturage and bran, cotton-seed meal, and linseed cake	3.31		
3	Do	4.07		

"During second period both groups shrunk in their milk as compared with the first period Dry weather, consequently poor pasture, was the cause.

"During the week when both groups received practically the same feed, group 2 produced 158 lbs. more milk than group 1. During the first period of the experiment, when group 2 received meal in addition to pasture and group 1 had only pasture, group 2 gave 541 lbs. more milk than group 1. This 383 lbs. is probably the extra milk produced from the meal fed. The extra meal fed these cows for a week would cost about $2.25, or the extra milk was made at a cost of about 58 cts. per 100 lbs."

Effect on the per cent of fat when cows are fed slop, H. H. DEAN (*Ontario Agl. Col. and Exptl. Farm Rpt. 1893, pp. 150, 151*).—A study of the effect of mixing the grain with water, using 6 cows, 5 of which had been in milk 7 months or more. Previous to the trial the grain (not stated) was fed dry. The first week (Nov. 12–19) the slop was made of bran and cold water; the second week of bran, wheat, and cold water; and the third week of bran, wheat, and scalding water, feeding while warm. During the whole time about 6 lbs. of hay and 40 to 50 lbs. of silage per day was fed in addition. The results of composite tests of the milk of each cow are given.

"If we take the 6 cows as a group, their milk tested an average of 4.29 for the week previous to the experiment, 4.15 the first week after receiving slop, 4.33 the second week, and 4.46 the last or third week during which they were 'slopped.'

"The week previous to the experiment these 6 cows gave 829 lbs. of milk, the first week after they shrank to 755, the second week they gave 635, and the last week 615 lbs. of milk. We would naturally expect these cows to shrink in their flow of milk. . . . They shrank more, however, after slopping commenced than before. . . .

"This experiment would indicate that 'slopping' is an expensive way to feed cows, and there need be little wonder, when the physiology of a cow is considered. By feeding wet food it passes more or less directly to the third and fourth stomachs without being remasticated, as is done when the food is given dry. More experiments are needed to settle the question."

Ground wheat as a food factor for milch cows, C. A. ZAVITZ (*Ontario Agl. Col. and Exptl. Farm Rpt. 1893, pp. 123–125*).—This is a comparison of wheat with an equal amount of a grain mixture of 2 parts of oats, 1 of peas, and 1 of barley, all ground. Four grade cows fresh in milk were divided into 2 lots and fed for 2 periods of 60 days each—February 23 to June 22. Hay, straw, and silage were fed with the grain. In the first period lot 1 was fed the mixed grain and lot 2 the wheat, and in the second period the lots were reversed.

No analyses are given of the milk, but the total yields are given as follows:

	Pounds of milk.
Group I.—First 60 days mixed-meal ration	3,555½
Group II.—Second 60 days mixed-meal ration	2,865½
Group II.—First 60 days ground-wheat ration	2,890½
Group I.—Second 60 days ground-wheat ration	2,892

"This seems to indicate that the mixed-meal ration kept up the flow of milk better than the ration of ground wheat."

The oats were valued at 24.5 cts., peas at 57 cts., barley at 38 cts., and wheat at 60 cts. per bushel, and hay at $6, straw at $2, and silage

at $1.75 per ton. At these rates the average cost of food per 100 lbs. of milk was 46 cts. while on mixed grain and 57 cts. while on ground wheat.

Experiments in feeding wheat to milch cows, H. H. DEAN (*Ontario Agl. Col. and Exptl. Farm Rpt. 1893, pp. 151, 152*).—Two trials are reported in feeding 8 lbs. of ground wheat, 6 lbs. of hay, and 50 lbs. of silage to milch cows. With ground wheat at $20 a ton there was a fair profit. Substituting 4 lbs of wheat bran, at $12 per ton, for 4 lbs. of the ground wheat "gave more profit than wheat alone."

"We would recommend dairymen to try a ration of wheat and bran or wheat and oats during the winter, and if it is fed to the right kind of cows and the product handled properly we feel confident that it will pay better than selling wheat at present prices."

A precocious milker, H. H. DEAN (*Ontario Agl. Col. and Exptl. Farm Rpt. 1893, p. 138*).—The udder of a heifer 15 months old had so developed that she was milked. The quantity of milk was at first small, but increased slightly.

"In appearance it was very watery at first but kept improving. The most interesting part is the fat content of this milk-like secretion. The first time she was tested—on the 7th of July—the per cent of fat was 0.4 per cent. On July 8th she tested 1.2 per cent, showing a marked increase in this short time. July 12 she again tested 1.2 per cent."

"At the time when we commenced milking her she had not been bred, but in a day or so after she was mated." By November 10 the yield had decreased to about a pint a day, but the fat had increased to 3.8 per cent. "So far it has not apparently affected her health or growth. It is too soon yet to see the effect on the milking ability."

It is mentioned that in the case of another cow the milk from a quarter of the udder that had been injured contained only 0.5 per cent of fat, while that from the other three quarters contained 3.4 per cent.

Feeding experiments with sheep, C. D. WOODS and C. S. PHELPS (*Connecticut Storrs Sta. Rpt. 1893, pp. 28–42*).—The object was to compare the effect of a wide and a narrow ration on the production of fat and lean meat. Twelve grade Shropshire wethers, averaging about 72 lbs., were divided into 2 lots. One was selected from each lot and slaughtered and the carcass analyzed. The others were sheared and fed from December 29 to March 29, 84 days, as follows: Lot 1, hay, turnips, and corn meal, the ration having an average nutritive ratio of 1:8.2; and lot 2, hay, linseed meal, pea meal, wheat bran, and corn meal, the nutritive ratio being 1:4.1. The sheep were fed in separate pens, and all food left uneaten was weighed back. At the conclusion of the experiment the sheep were all sheared, slaughtered, and analyzed. The data for the experiment, including amounts and composition of food eaten, individual gains in weight, analyses of carcasses, and weight of parts, are tabulated. A summary of the gains and food eaten follows:

Averages of digestible nutrients eaten and gain in live and dressed weights per animal.

All averages per animal.	Digestible nutrients in food actually eaten.				Increase.	
	Total organic matter.	Protein.	Fat.	Carbohydrates.	Live weight, including fleece.	Dressed weight.
Whole period of 84 days:	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds*
Wide ration	160.90	18.90	7.60	134.40	23.0	13.7
Narrow ration	159.50	32.70	5.00	121.80	26.5	15.6
To produce a gain of 1 lb. live weight:						
Wide ration	6.99	0.82	0.33	5.84	1.0	0.6
Narrow ration	6.02	1.23	0 19	4.60	1.0	0.6
To produce a gain of 1 lb. dressed weight:						
Wide ration	11.74	1.38	0.55	9.81	1.7	1.0
Narrow ration	10.23	2.10	0.32	7.81	1.7	1.0

The analyses of the flesh freed from bones are given below:

Percentage composition of flesh (edible portion) of sheep.

	Calculated on water-free basis.			Calculated to water content of flesh.			
	Protein.	Fat.	Ash.	Water.	Protein.	Fat.	Ash.
At beginning of experiment:	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Sheep No. 1	44.50	52.90	2.60	59.95	17.83	21.18	1.04
Sheep No. 2	38.27	59.40	2.33	56.77	16.54	25.68	1.01
Average 1 and 2	41.39	56.15	2.46	58.36	17.19	23.43	1.02
Wide ration:							
Sheep No. 3	38.20	59.66	2.14	58.13	16.00	24.97	0.90
Sheep No. 4	35.97	62.06	1.97	58.07	15.07	26 03	0.83
Sheep No. 5	36.22	61.79	1.99	58.24	15.13	25.81	0.82
Sheep No. 6	32.15	66.12	1.73	57 23	13.75	28 28	0.74
Sheep No. 7	32.03	66.26	1.71	55.07	14.39	29.77	0.77
Average 3–7	34.91	63.18	1.91	57.35	14.87	26.97	0.81
Narrow ration:							
Sheep No. 8	34.31	63.89	1.80	56.35	14.96	27.91	0.78
Sheep No. 9 [1]	53.84	43.33	2.83	68.27	17.08	13.76	0.89
Sheep No. 10	38.63	59.29	2.08	59.63	15.59	23.94	0 84
Sheep No. 11	38.54	59.38	2.08	61.18	14.96	23.05	0.81
Sheep No. 12	34.65	63.55	1 80	58 21	14.50	26.55	0 74
Average 8, 10–12 (4)	36.54	61.52	1.94	58.84	15.00	25.37	0 79

[1] Omitted from averages.

From the above data a calculation is made of the total amounts of food nutrients in the carcasses of the sheep killed at the beginning and close of the experiment.

"In the dry matter of flesh there was in each group an increase in the fat and a corresponding decrease in protein and ash. These differences were greater in the wide ration group.

"The chief differences in composition between the different groups, when calculated to fresh substance of flesh, are still due to the fat. One of the facts brought out very early in our study of the composition of animal foods was, that water and fat to a very great extent replace each other. This is strikingly shown in the composition of the flesh of the animals of the wide and narrow rations. The protein is nearly the same in each, while the flesh of the narrow-ration animals contains 1.5 lbs. per 100 more water and 1.6 lbs. per 100 less fat than that of the wide-ration group."

The work is being continued.

Fattening lambs for the British market, C. A. ZAVITZ (*Ontario Agl. Col. and Exptl. Farm Rpt. 1893, pp. 126–129*).—From a lot of 369 lambs 98 were chosen for fattening and shipping to England. The trial commenced the middle of September and the lambs were sold in Liverpool May 22. During the fall the lambs were fed on rape, and later upon mixed grain composed of oats, peas, wheat, and bran unground, together with hay, sliced turnips, and silage. The lambs were sheared October 11. The financial result, allowing for the cost of attendance, the expense of shipment to England and sale, the value of the wool and of the manure, shows a total profit of $377.10, or $3.85 per head.

The college has now shipped lambs to England for 3 seasons. The cost for shipment and sale per pound of live weight has been 3.43, 2.73, and 2.15 cts., respectively, and the price received in England per pound of live weight, less the cost of transportation, has been 5.30, 5.91, and 5.95 cts., respectively

Experiment in feeding lambs on different rations, C. A. ZAVITZ (*Ontario Agl. Col. and Exptl. Farm Rpt. 1893, pp. 125, 126*).—This is a comparison of corn silage and roots on the one hand, and of oats and wheat on the other. Four lots of 24 lambs each were fed for this purpose from December 29 to April 28, 120 days. The first 2 lots received mixed grain and hay, to which roots were added for lot 1 and silage for lot 2. The other 2 lots received hay and roots, with whole oats for lot 3 and wheat for lot 4. The largest gains were made by lot 4 (wheat) and lot 1 (roots). The other 2 lots made practically the same gain. At the prices charged the rations of these 2 lots were the most expensive, so that the cheapest gain was made by lot 2 on mixed grain, hay, and silage.

Feeding of swine, J. W. ROBERTSON (*Canada Exptl. Farms Rpt. 1893, pp. 71–76*).—The results of 3 tests of pigs of different breeds or breeding are tabulated. In the first experiment the 12 pigs were fed for 12 weeks frozen or frosted wheat ground and soaked in water for about 18 hours. No conclusions are given as to the results of the different breeds, but only the results for the food fed in each trial. "On the average 5.26 lbs. of frosted wheat were consumed per pound of increase in live weight."

In the second trial the 21 pigs were fed for 12 weeks on a mixture of equal parts (by weight) of barley and frosted wheat, both ground and soaked in cold water for about 30 hours. After the first week a quantity of pulped carrots, equal to about one fifth of the grain consumed, was given. "On the average 4.45 lbs. of barley and frosted wheat, both ground and soaked, and 0.85 lb. of pulped carrots were consumed per pound of increase in live weight."

In the third experiment 36 pigs were fed for 12 to 15 weeks on a mixture of equal parts (by measure) of ground barley, frosted wheat, and bran, all soaked in cold water for 8 to 18 hours. "On the average 3.83 lbs. of the mixture of barley, rye, frosted wheat, all soaked, and wheat bran were consumed per pound of increase in live weight."

Feeding barley to swine, S. A. BEDFORD (*Canada Exptl. Farms Rpt. 1893, pp. 254, 255*).—Two grade Berkshire pigs weighing together 117 lbs. were fed for 4 months in winter chopped barley mixed with water, *ad libitum*. They were bought at 5 cts. per pound and sold at the same rate. "It took an average of 4 lbs. 11 oz. of barley during the 4 months to make 1 lb. of pork. The average return per bushel of barley fed was 50 cts. . . . Farmers at that time were selling the same grade of barley on the maket at an average of 25 cts. per bushel."

Relative food value of corn and wheat for hogs (*Agl. Student, 1 (1894), No. 1. pp. 8, 9*).—This experiment was made by the department of agriculture of the Ohio State University. Nine high-grade Poland-China pigs, averaging 135 lbs. each, were divided into 3 lots after a preliminary feeding, and fed from February 3 to April 23 as follows: Lot 1, wheat; lot 2, corn; lot 3, a mixture of equal parts by weight of corn and oats. The grain was fed whole and dry. The corn appeared to be better digested than the wheat, judging from the dung. Nearly the same amounts of grain were eaten by all 3 lots. The gain made by the lot on corn was slightly below that of the other lots.

"A bushel of wheat made 13.7 lbs. of pork, while a bushel of corn made 12.3 lbs. . . . The hogs sold for $5.15 per hundredweight. Putting aside the question of labor, a bushel of wheat brought us 70.5 cts. and a bushel of corn 63.3 cts. With wheat at 55 cts. per bushel the cost of food for 100 lbs. of increase was $4.01, while with corn at 35 cts. per bushel the cost of the food for 100 lbs. of increase was $2.85."

Feeding frozen wheat to swine, S. A. BEDFORD (*Canada Exptl. Farms Rpt. 1893, p. 254*).—Two grade Berkshire pigs weighing about 90 lbs. each were fed for 4 months during very cold weather all the chopped, badly frozen wheat they would eat, mixed with cold water but not soaked. They were bought at 5 cts. per pound and sold at the same price. "It took on an average 6 lbs. 1 oz. of wheat during the 4 months to make 1 lb. of pork. The average return per bushel of wheat consumed was 49 cts."

Report of the poultry manager, A. G. GILBERT (*Canada Exptl. Farms Rpt. 1893, pp. 194–212, figs. 8*).—The results are given of a study on egg and feather eating; a plan for a poultry house; popular directions for caring for poultry, feeding, etc.; descriptions of a number of different breeds, with the average weight of the separate eggs; the number of eggs laid by different breeds during the winter months; the gain in weight by the chickens from these breeds; and remarks on poultry diseases.

The conclusions arrived at in regard to egg and feather eating were as follows:

"(1) It is imperative that the layers be kept in constant activity.

"(2) They must have plenty of room to scratch in.

"(3) The pullets are better separated (when possible) from the older fowls.

"(4) Plenty of green stuff should be fed in the shape of clover hay, cabbage, mangels, turnips, etc.

"(5) Green bones, cut up and fed regularly, are the best preventives.

"(6) The laying stock should have access to barn, shed, or stable to scratch in whenever circumstances permit.

"(7) The nest boxes must be so arranged that they will be dark and not too easy to get to.

"(8) The more limited the quarters the greater the necessity of exercise.

"(9) The more natural the conditions under which the layers are kept during the close season the better for them, the more profitable the result.

"[In regard to the production of eggs] the experience of last and previous winters confirms what has been written in previous reports, viz:

"(1) Pullets should be hatched out as early as possible.

"(2) The laying stock should be young, and birds of the same age should be in the one pen.

"(3) A warm or comfortable house is more economical in the long run than a cold one.

"(4) What will go into eggs in the pullets will make the hens of the heavy breeds too fat to lay.

"(5) The laying stock require ample room."

The breeds which did the best during the cold season were the Plymouth Rocks, Black Minorcas, Andulusians, Red Caps, and White Leghorns.

"[For growing chicks] a splendid mash was found to be shorts, corn meal, bran, bone meal, and bread and table scraps from the houses of the farm, the whole being mixed up with boiling milk or water. Where milk is in abundant supply it will be found one of the best foods for the growing chicks or the laying hens.

"The most rapid growth was made by a White Plymouth Rock which, hatched on May 20, weighed on October 21 following 6 lbs., representing a development of 19 oz. per month. This gain may not represent that made in the first month after hatching, but it was subsequently made up.

"The next best growth was made by a cross of the Langshan—Black Minorca breeds, the Langshan male being used. This cockerel was hatched on May 11 and weighed on October 21 5 lbs. 15 oz. The Barred Plymouth Rocks came next, closely followed by the Wyandottes, both White and Silver-Laced. In some cases the weights were the same.

"The White and Silver-Laced Wyandottes made about the same progress. Both represent a development of 1 lb. per month, taking the heaviest weights."

Egg fertility (*Agl. Student, 1 (1894), No. 1, pp. 6, 7*).—On the farm of the Ohio State University 40 Leghorn hens, which had previously been kept without males, were placed in pens with 3 male birds February 18, and the percentage of fertile eggs observed for 9 days after mating. This increased regularly from 0 on the day of mating to 95 per cent. on the eighth day after mating. July 1 the males were removed from the pens. "The fertility of the eggs was apparently not materially affected until the twelfth day after removing the roosters. . . . Unfortunately the eggs were only saved 15 days, and hence it is not shown how long hens must be removed from the male before all the eggs become infertile."

Some chemical considerations [in regard to feeding], J. H. SHEPARD (*South Dakota Sta. Bul. 40, pp. 15–25*).—An explanation of the scientific principles of feeding, tables of composition and digestibility of feeding stuffs and feeding standards, and directions for compounding rations.

On the nutritive value of Graham bread, BARDET (*Pharm. Ztg., 39, p. 553; abs. in Chem. Centbl., 1894, II, No. 13, p. 592*).—Regards it as a suitable substitute for

meat. Properly prepared it contains 40 per cent of gluten, as compared with 25 per cent in rye bread.

Hygienic studies on flour and bread, V. Contribution to the physical nature of bread, K. B. LEHMANN (*Arch. Hyg., 21, No. 3, pp. 215–246*).

Hygienic studies on flour and bread, VI. Concerning a bread made directly from cereal grains without grinding, K. B. LEHMANN (*Arch. Hyg., 21, No. 3, pp. 247–267*).

Hygienic studies on flour and bread, VII, A. WOLFFIN (*Arch. Hyg., 21, No. 3, pp. 268–307*).—Treats of the different kinds of fermentation of the dough, of which he recognizes 3.

Resorption of fat, O. FRANK (*Du Bois Reymond's Arch. Anat. und Physiol., 1894, No. 3 and 4, pp. 297–308*).

Feeding value of stock foods, T. F. HUNT (*Ontario Agl. Col. and Exptl. Farm Rpt. 1893, pp. 271–279*).—A popular article.

Grape leaves as food for beasts, A. CADORET (*Prog. Agr. et Vit., 11 (1894), No. 42, pp. 426, 427*).

The use of molasses as a feed stuff (*Fühling's landw. Ztg., 43 (1894), No. 19, pp. 605–608*).—A popular article.

Hay from oat and barley fodder vs. native hay, A. MACKAY (*Canada Exptl. Farms Rpt. 1893, p. 307*).—A trial with 2 heifers "serves to show that a mixed crop made into hay gives as good results . . . as the best native hay."

Poisonous fodder plants, J. R. JACKSON (*Jour. Soc. Chem. Ind., 13 (1894), No. 9, p. 897*).

Dairy stock, H. H. DEAN (*Ontario Agl. Col. and Exptl. Farm Rpt. 1893, p. 135*).—A record for the year of the individual cows of the college herd, including the range and average fat content of the milk, and yield of butter. The butter yield ranged from 64.9 lbs. to 376.4 lbs., the latter being from a cow milked 252 days and giving 6,569 lbs. of milk, with a fat content ranging from 4.22 to 6.4 per cent.

On the improvement of dairy animals, G. BEHM (*Nord. Mejeri Tidn., 9 (1894), pp. 354, 355, 366, 367*).

Evolution of the British breeds of cattle, T. MCK. HUGHES (*Jour. Roy. Agr. Soc. England, ser. 3, 5 (1894), No. 19, pp. 561–563*).

Influence of Dexter cattle on other breeds, W. J. MALDEN (*Jour. Roy. Agr. Soc. England, ser. 3, 5 (1894), No. 19, pp. 531–540, figs. 6*).

The Jutland breed of dairy cattle, S. P. PETERSEN (*Mälkeritid., 7 (1894), pp. 449–460*).

Slaughter experiments at the Berlin Fat Stock Show in 1894, C. LEHMANN (*Deut. landw. Presse, 21 (1894), No. 78, pp. 743, 744, figs. 7; No. 79, pp. 751, 752*).

Kjelleström's cattle measuring band and its application (*Tidskr. Landtmän, 15 (1894), pp. 724–729*).

The sunflower as food for cattle, J. W. ROBERTSON (*Canada Exptl. Farms Rpt. 1893, pp. 76–84*).—Notes on the use of the heads of sunflowers in silage, and on the cultivation of sunflowers.

A food for increasing the yield of milk, T. KLUTENTRÉTÉR (*English Patent; Jour. Soc. Chem. Ind., 13 (1894), No. 9, p. 898*).—The patent covers the process of manufacturing a food which it is claimed increases the production of milk. The food is made by mixing 80 parts of basic phosphate of lime, 2½ of albumen, 2½ of yolk, and 15 of powdered sugar. The mixture is then ground. A daily dose of 75 gm. of this food is said to increase the production of milk by 2 liters.

The relative value of skim milk and whole milk for calves, M. PETERSEN (*Braunschw. landw. Ztg., 62 (1894), No. 41, pp. 174, 175*).—A popular article giving weights of calves differently fed.

Wheat fed to hogs, G. E. SCOTT (*Rural New Yorker, 53 (1894), No. 2334, p. 664*).—Recapitulation of experiments showing that wheat at 50 cts. per bushel is economical feed.

Feeding lambs on rape, C. A. ZAVITZ (*Ontario Agl. Col. and Exptl. Farm Rpt.

1893, p. 125).—Sixty lambs were pastured upon an acre of rape for 23 days, September 18 to October 11. At the end of this time they had eaten the crop and were changed to another portion of the field.

Feeding lambs and pigs, I. P. ROBERTS and G. C. WATSON (*New York Cornell Sta. Rpt. 1892, pp 353–356, figs. 2*).—A reprint of Bulletin 47 of the station (E. S. R., 4, p. 572).

VETERINARY SCIENCE.

Parasitism, C. W. STILES (*Proc. Ent. Soc. Washington, 3 (1894), No. 1, pp. 1–9*).—A general discussion of parasitism from the standpoint of the helminthologist. The author makes the following divisions: A, based upon symbiosis and food—(1) mutualists; (2) commensalists; (3) true parasites; (4) pseudo-parasites; and (5) spurious parasites. B, based upon position—(1) ectoparasites; (2) endoparasites. C, based upon the animals and plants—(1) phytoparasites, (*a*) in or upon animals, (*b*) in or upon plants; (2) zoöparasites, (*a*) in or upon animals, (*b*) in or upon plants. D, based upon time—(1) temporary parasites; and (2) stationary parasites, including (*a*) periodical parasites and (*b*) permanent parasites. E, based upon adaptation or necessity—(1) facultative parasites; (2) obligatory parasites. F, based upon the number of hosts—(1) monoxenous parasites; (2) heteroxenous parasites. Connecting links exist between various divisions.—C. W. STILES.

A new human parasite, R. MONIEZ (*Rev. Biol. d. Nord France, 6 (1894), No. 11, pp. 419–434*).—Description, life history, and anatomy of *Tydeus molestus*, a new species of acarid which attacks man in Belgium. During 1888 this mite became extremely abundant in the gardens of a large property situated not far from Ath, in Belgium, where it had been noticed in smaller numbers for 25 years. It is suspected that it was introduced with guano from Peru. In passing through the gardens and brushing against the vegetation one becomes covered with the mites, which produce an irritation similar to that of the larval Trombidiums, commonly called jiggers or red bugs. The mite also fixes itself upon domestic animals, particularly in the joints, around the eye, and in the anus. Young ducks especially suffer from this parasite and are even killed by its attacks. As a remedial measure it was proposed to plow up the sod of the garden several times during the summer, and sprinkle the soil heavily with manure water and lime-water, uprooting at the same time all shrubs and plants with hairy leaves. The author did not learn whether this treatment produced satisfactory results or not.—L. O. HOWARD.

Occurrence of Distoma westermanni in the United States, H. B. WARD (*Centbl. Bakt. und Par., 15 (1894), pp. 362–364; Vet. Mag., 1894*).—*Distoma westermanni* is a fluke found in man (China and Japan), cats, dogs, and tigers. Ward has recently found it in a cat in Ann Arbor, Michigan. The specific diagnosis, geographical distribution, synonymy, and full bibliography of this fluke is given by Stiles.[1]—C. W. STILES.

[1] Johns Hopkins Hospital Bul. 24, 1894, figs. 3; Vet. Jour., 1894, pp. 107–110.

Notes on parasites, C. W. STILES and A. HASSALL (*Vet. Mag., 1894, pp. 413–433, pls. 4*).—*A new species of fluke.*—Description of *Distoma* (*Dicrocœlium*) *complexum* found in cats in the United States, with bibliographies and diagnoses of allied forms. This parasite, closely related to *D. albidum*, has been found in New York, Maryland, and the District of Columbia. It causes a slight inflammation in gall ducts. The other species described and figured are *D. truncatum*, found in cats, dogs, and seals; *Halichœrus fœtidus* and *Gulo borealis* (Germany, Holland, Italy, and France); *D. albidum*, found in cats (Germany and France); *D. viverrini* in *Felis viverrina* (France); *D. tenuicolle* in *Phoca barbata; D. conjunctum* in the American fox (*Canis fulvus*) and in man (India); *D. lanceolatum*, of sheep, cattle, man, etc. (cosmopolitan); *D. longissimum* of *Ardea stellaris* (Turkestan); *D.* (?) *longissimum corvinum* in crows of this country. The authors doubt whether *D. conjunctum* of the American fox is identical with *D. conjunctum* recorded for man in India. An analytical key to species is given.

A case of Echinococcus in a camel.—Thus far this hydatid has been recorded in this country a number of times for man, 123 times for hogs (Maryland, District of Columbia, Nebraska, and Louisiana), and once (adult stage) for dogs (District of Columbia). Osler found it in 2.9 per cent of the (1,037) hogs examined in Montreal. The new case was that of a tuberculous camel belonging to a traveling circus. In addition to the above, mention is made of an interesting anomaly in *Moniezia planissima*, *i. e.*, abnormal (dorsal) position of genital pore of this tapeworm of cattle.—C. W. STILES.

A preliminary catalogue of the parasites, C. W. STILES and A. HASSALL. (*Vet. Mag., 1894, pp. 245–253, 331–354*).—Contains lists of specimens in the collection of the Bureau of Animal Industry of this Department, the U. S. Army Medical Museum, the Biological Department of the University of Pennsylvania, of C. W. Stiles and of A. Hassall. These are arranged zoölogically, giving parasite, host, locality, collector, and collection in which specimen is deposited. Many of the specimens are type-specimens of Rudolphi, Cobbold, Braun, Stiles, and Hassall, and will be deposited in the U. S. National Museum.—C. W. STILES.

On the preservation of types of parasites, C. W. STILES (*Centbl. Bakt. und Par., 15 (1894), pp. 477–480*).—The author urges that all type-specimens of parasites shall be deposited in the national museum of the country in which the type-specimen is taken.—C. W. STILES.

Notes on animal parasites, M. FRANCIS (*Texas Sta. Bul. 30, pp. 450–452*).—A list of 45 animal parasites found by the author in Texas. [The form described as *Distomum* (sp.?) from the opossum is evidently *Rhopaloporus coronatus.*]—C. W. STILES.

Actinomycosis, M. FRANCIS (*Texas Sta. Bul. 30, pp. 448, 449*).—Brief notes on the dose of iodid of potassium employed and on each

of the 5 cases treated, 4 of which apparently recovered as the result of the treatment. In 1 case the treatment was believed to have caused abortion.

Actinomycosis and the iodid treatment, W. B. NILES (*Iowa Sta. Bul. 25, pp. 44–47*).—A brief popular article on the nature and cure of actinomycosis, with a brief statement of favorable results obtained in the treatment of 1 case at the station.

Experiments on glanders, M. FRANCIS (*Texas Sta. Bul. 30, pp. 439–445, dgm. 1*).—A record of the temperatures of 20 animals injected with mallein, and brief notes on the cases inoculated.

"The experiments seem to show that in the mallein we have found a convenient, safe, and reliable diagnostic agent for glanders; that the more occult the disease the more positive the temperature reaction. It also seems that the size, form, and character of the lump produced at the point of injection is of great value."

Louping-ill in sheep, J. M. MCFADYEAN (*Jour. Roy. Agl. Soc. England, ser. 3, 5 (1894), No. 19, pp. 547–660*).—*Post-mortem* examinations were made of 15 sheep attacked with this disease in the county of Northumberland, England. Nine inoculation experiments were also made. In the case of 2 diseased sheep, cultures were made from pus. Experiments with these cultures led to the conclusion that in these 2 cases a specific organism was the cause of the disease designated as louping ill. In the other inoculation experiments the results were negative.

The author states that the term louping ill includes several morbid conditions, of which the following are the principal: (1) Pyæmic spinal meningitis, caused by pyogenic bacteria; (2) gastritis and enteritis, from indigestible substances (wool, sand, dried grass) in the stomach or intestines; and (3) disorders of brain functions, paralysis, and general weakness, with in some cases excess of cerebro-spinal fluid in the cranial cavity, but without gross lesions in any of the organs of the body. Lambs are especially subject to the first two conditions and sheep to the last.

A résumé of previous investigations on this disease is given.

Sheep scab (*Ann. Rpt. Vet. Dept. [British] Bd. Agr. 1893, London, 1894, pp. 54, 55*).—During the past year sheep scab was more widely spread in Great Britain than in any of the 5 preceding years. It existed in 86 counties as compared with 82 in 1892, 80 in 1891, and 75 in 1890. Only 10 of the 96 counties in Great Britain were entirely free from the disease last year. The number of outbreaks in Great Britain last year was 2,603 as compared with 2,821 in 1892, while the number of sheep attacked was 45,393 as compared with 53,214 in the previous year. The increased prevalence of sheep scab in Great Britain is due entirely to Wales, as there was a decrease in both England and Scotland.—C. W. STILES.

Texas fever experiments, M. FRANCIS (*Texas Sta. Bul. 30, pp. 453–456*).—Common cattle ticks (*Boöphilus bovis*) and "Lone Star"

cattle ticks (*Amblyomma unipunctata*) were sent to the Kansas Experiment Station, where the former were placed on a heifer which subsequently died. The ticks of the latter species were placed on 2 young calves; the temperatures of these calves subsequently never exceeded 104°.

Tuberculosis (*North Dakota Sta. Bul. 14, pp. 35-47*).—A popular article on the occurrence, cause, and symptoms of tuberculosis, together with a record of temperatures of 5 animals inoculated with tuberculin. The statement is made that there is very little tuberculosis in the herds of the State, but that the number of cases is somewhat on the increase each year.

The animal parasites which we obtain through our food, C. W. STILES (*Pop. Health Mag., 1 (1894), pp. 337-342; Nat. Pop. Monthly, 5 (1894), pp. 165-169*).—A popular article on the parasites which may be obtained from beef, pork, and other foods when not properly cooked.—C. W. STILES.

Strongylus ostertagi vs. S. convolutus, C. W. STILES (*Ztschr. Fleisch- und Milchhyg., 5 (1894), pp. 151-153*).—This parasite of cattle was described by Ostertag under the name *Strongylus convolutus;* as the specific name was preoccupied, Stiles changed the name to *Strongylus ostertagi;* Stadelmann declared this change absurd, and in the above paper the author gives his reasons for the change of name, quoting the rules of nomenclature.—C. W. STILES.

A case of actinomycosis in the spine of a cow, J. WETTERWIK (*Nord. Mejeri Tidn., 9 (1894), p. 428*).

Glanders and farcy (*State Board of Health of Tennessee, pp. 4*).—This pamphlet gives the text of the State law relative to the prevention and spread of communicable diseases among domestic animals, and the regulations adopted by the board of health for the restriction and prevention of glanders and farcy.

Hog cholera (*State Board of Health of Tennessee, pp. 7*).—This pamphlet gives the sources of infection as (1) pigs from infected herds or farms; (2) contaminated streams; (3) the conveyance of the virus in the feed, implements, or on the feet or clothing of the attendants; (4) insects and birds. The methods of caring for the herds, as disinfecting the soil and premises on the farms where hog cholera has occurred, are given.

Production of pleuropneumonia of cattle experimentally by means of cultures (*Compt. Rend., 119 (1894), No. 2, pp. 143-146*).—Researches on the cause of the above-mentioned disease.

Splenetic (Texas) fever, its restriction and prevention (*State Board of Health of Tennessee, pp. 4*).—This pamphlet gives the text of the State law relative to the prevention and spread of communicable diseases among domestic animals, and the regulations adopted by the board of health for the restriction and prevention of Texas fever.

Experiments with tuberculin, M. FRANCIS (*Texas Sta. Bul. 30, p. 447*).—A record of the temperatures of 6 animals, 4 of which were inoculated with tuberculin.

Directions for the application of tuberculin for the diagnosis of bovine tuberculosis, O. MALM (*Rpt. Bio. Chem. Lab. Christiania, 1891-'93, I, pp. 125-133*).

Acorn poisoning (*Leaflets Bd. Agr. England, 1893, pp. 69, 70*).—A popular article calling attention to a disease of young cattle caused by eating acorns.

Poisonous effects of feeding Lathyrus sativus seed (*Kew Misc. Bul. 94 (1894), pp. 349, 352*).—A popular article.

Measures for the repression of cattle plagues in Germany (*Milch Ztg., 23 (1894), No. 40, p. 641*).

A device for dipping cattle to destroy ticks, M. FRANCIS (*Texas Sta. Bul. 30, pp. 457, 458, dgms. 2*).—An illustrated description of a tank for dipping cattle and an estimate of the cost of construction.

Formic aldehyde as a rapid hardening reagent for animal tissues, W. M. ECCLES (*Internat. Jour. Micr. and Nat. Sci., 4 (1894), ser. 3, pp. 371, 372*).

DAIRYING.

The composition of milk, cheese, and whey and their relation to one another, A. E. SHUTTLEWORTH (*Ontario Agl. Col. Bul. 96, pp. 9–16*).—The chemical work done in connection with the experiments in cheese-making reported above is given in detail and the summarized analyses of milk, whey, green cheese, and cured cheese are compared with American analyses. The 2 sets of analyses agree quite closely, and the results of analyses of whey lead the author to agree with the conclusion of the New York State Station that "the loss of fat in cheese-making is quite independent of the amount of fat in the milk." The payment of milk according to test is discussed and the ratio is given of fat to casein in a number of samples of milk, which "reveals a gradual decrease with some variation in the proportion of casein to fat as the milk increases in richness." The following statement is given in regard to the yield of cheese from milk of different quality:

"Fifteen hundred pounds of milk L, containing an average of 3.302 per cent of fat or a total of 49.539 lbs., yields 144.25 lbs. of green cheese, being 2.9 lbs. of cheese for each pound of fat. The same weight of milk H, containing an average of 3.919 per cent of fat or a total of 58.731 lbs., yields 158 lbs. of green cheese, being 2.6 lbs. of cheese for each pound of fat. Under exactly similar conditions of handling, the rich milk yields 13¾ lbs. more cheese than the poor milk, but the poor milk makes 0.3 lb. of cheese more for every pound of fat than does the rich milk."

From a calculation the author concludes that supposing H and L to represent 2 patrons, by paying for the milk by weight, patron L, supplying the poorer milk, would be paid 62 cts. more and patron H 62 cts. less than his share based on the value of the cheese made; by paying on the basis of fat content patron L would be paid 75 cents too much and patron H 75 cts. too little.

Desiccated milk, F. T. SHUTT (*Canada Exptl. Farms Rpt. 1893, p. 151*).—This substance, which is a yellowish-white powder, was obtained from Prince Edward Island, where it is made by the evaporation of milk to which a certain amount of cane sugar has been added. It is claimed that the powder may be preserved in good condition and palatable for a length of time, even though exposed to the atmosphere. Analysis showed the following composition: Water, 5.44 per cent; fat, 21.73; albuminoids, 18.01; milk sugar, 25.22; cane sugar, 26.45; and ash, 63.15.

Chemical action of a "new" bacteria in milk, A. BERNSTEIN (*Abs. in Milch Ztg., 23 (1894), No. 34, pp. 542, 543*).—In a paper before the

British Association the author described a bacteria which he has discovered, and its peptonizing action on milk. The bacteria are very small, hardly 1 μ long, capable of rapid motion, produce colorless liquid colonies on peptone gelatin, a whitish slimy product on agar, and a smooth, brown skin on potato. He has given it the name *Bacterium peptofaciens*. A chemical examination of the products showed that more than half of the casein was changed to albumen and peptone. Some lactic acid and a little acetic and butyric acid was produced. No gas was generated, even after a week. The sulphur of the casein remained in the peptone.

It is claimed that the bacteria can be practically used in peptonizing and rendering soluble the casein in milk, making it a very easily digestible food. To this end skim milk is inoculated with the bacteria, and after an incubation of 8 days at 20° C. the milk is heated to stop the action of the bacteria. This coagulates the casein which has not been changed, and the liquid portion is filtered off. The latter is evaporated somewhat, and is then called "galactone." An advantage is claimed for it over beef peptone in that it contains gluten peptone, which probably accounts for its better taste, and that no chemicals are used in its preparation. By using the proper yeast it is said that an alcoholic beverage can be made from galactone.

The Nahm milk test, A. N. NAHM (*Milch Ztg., 23* (*1894*), *No. 35, pp. 555–558, figs. 3*).—In this method, which is said to be new, 100 cc. of milk is boiled for about 25 minutes with a mixture composed of 4.5 parts of potassium hydrate, 56 of ethyl alcohol, 15.5 of amyl alcohol, and 24 of 30 per cent ammonia, and the fat separated read off on a scale. The construction of the tubes is somewhat peculiar. The bottom of the bulb is a rubber cap, which is compressed to raise the fat up into the neck, where it is read off. When the column is adjusted a cock at the top of the tube is closed to hold it in place. The scale reads to hundredths and gives the percentage of fat directly. The tubes are heated in a water bath and shaken every 5 minutes. It is said that 8 tests can be made in an hour and a quarter.

In all comparisons with the gravimetric method the largest difference was 0.055 on a sample with 1.5 per cent of fat, and the average difference was 0.012 per cent. In 14 other comparisons the Nahm test differed by 0.005 per cent from the gravimetric and 0.009 per cent. from the Soxhlet aërometric method. Skim milk with 0.05 per cent of fat was satisfactorily tested. The method and apparatus are patented.

The Babcock test, F. T. SHUTT (*Canada Exptl. Farms Rpt. 1893, pp. 149–151*).—Four experiments are reported, which were made to determine the amount of potassium bichromate to be used in preserving milk samples, and the length of time that composite samples can be preserved with this material without showing a diminution in fat content. The conclusion is that "the exact amount of potassium bichromate to be added is of no moment. For ordinary work from 3

to 5 grains, measured roughly on the point of a knife or in a small spoon, is ample." Samples of milk were preserved with 18 and 36 grains of bichromate of potassium, respectively, from May 27 to July 7, with practically no change in the fat content.

"After this last date the fat in both samples became slightly curdy and the percentage gradually lower. The samples were shaken daily and tests made every week until September 26, when the respective readings were: A, 2.20 per cent fat; B, 2.50 per cent fat. Both samples had curdled and were measured with difficulty.

"For more than 7 weeks the milk had retained its fluidity and yielded a correct percentage of fat, though the preservative had been increased to 36 grains to the pint. . . .

"If the fat readings are obscure through charring, due to excess of the preservative, the quantity of acid must be slightly reduced."

Investigations of Babcock's, Thörner's, and Gerber's recent methods for the determination of fat in milk, J. SEBELIEN and K. STÖREN (*Norsk Landmandsblad, 13 (1894), pp. 325–329, 332–334*).—A thorough investigation of the methods mentioned convinced the authors that the results obtained by any of them, after some practice and when proper care is taken, will not differ more than 0.1 per cent, and by further practice will agree still better. As far as ease of manipulation goes, the authors give the Babcock test the first place. The Gerber method, lately modified for concentrated sulphuric acid and amyl alcohol, in the opinion of the authors has the advantage in ease of centrifuging and of reading. The first cost of the Gerber apparatus is least (according to Norwegian prices), while the running expenses are lowest in the Babcock method.—F. W. WOLL.

Berg's lactoscope, H. N. THOKE (*Mälkeritid., 7, 1894, pp. 486, 487*).—The lactoscope, which, judging from the description, is a modification of Fjord's "control centrifuge," gives the cream content of samples of milk, after whirling in a centrifuge for 15 minutes at the rate of 6,000 revolutions per minute. The author has used the lactoscope in his creamery for a year and believes it is destined to become generally used.—F. W. WOLL.

Composite tests, H. H. DEAN (*Ontario Agl. Col. and Exptl. Farm Rpt. 1893, pp. 144–147*).—Daily samples amounting to about 1 fluid ounce, and to one third and one sixth the amounts required for a test, respectively, were taken for several weeks, and the results of the test compared with the daily tests. The results agreed closely with those shown by the daily tests.

To see if the work of testing could not be lightened, composite samples were made for a number of weeks, preserving them by means of bichromate of potash. Composite samples covering 7 weeks agreed quite closely with the average of the daily tests for this period.

Gravity creaming, F. L. KENT (*Iowa Sta. Bul. 25, pp. 39, 40*).—Trials were made from October 17 to 20 in setting a part of the milk from the college herd in Cooley cans in ice water and creaming after 15 and 24 hours, respectively, to within 1 in. of the cream line. The

temperature of the milk when set was 87°, and the temperature of the water was 40°. The average results are given as follows:

Summary of results of creaming milk by Cooley system.

	Set 15 hours.	Set 24 hours.
	Per cent.	*Per cent.*
Fat in whole milk	3.25	3.25
Fat in first inch skim milk drawn	0.45	0.31
Fat in third inch below cream	0.64	0.60
Fat in second inch below cream	0.76	0.71
Fat in whole skim	0.57	0.52

"These results indicate that there is very little gain from setting milk more than 12 to 15 hours when ice is used. . . .

"These trials were made under the best possible farm conditions, except that the temperature fell somewhat before the milk was set. This and the fact that the cows were well along in the period of lactation may account for the loss in the skim milk being greater than has been found at some other stations."

Creaming—shallow pan, deep pail, and separator, H. H. DEAN (*Ontario Agl. Col. and Exptl. Farm Rpt. 1893, pp. 140, 141*).—During the 6 months from May to October the milk from the college herd was divided into 3 parts, one part being set in shallow pans, another in deep pails (ice water?), and a third run through a hand separator. The cream set by each method was churned by itself. The average per cent of fat in the skim milk and buttermilk in each method are tabulated.

"There was creamed 3,081 lbs. of milk—1,027 by each method. This milk contained 115.17 lbs. of butter fat and made 127.58 lbs. of butter. The total loss of fat in skim and buttermilk by separator method was 0.47 lbs., by deep pail 1.67, and by shallow pan 3.29 lbs. The per cent of loss in butter fat was 1.2 by separator, 4.3 by deep pail, and 8.5 by shallow pan. . . .

"As to the quality of the cream and butter, we could see little difference between the deep pail and separator. The separator butter was possibly a little better for a short time after being made, but the deep pail proved somewhat better in keeping quality. The shallow-pan butter was inferior to the others in every case, though it was fair in quality and was better in October and November than during hot weather."

Shallow pan—24 and 36 hours, H. H. DEAN (*Ontario Agl. Col. and Exptl. Farm Rpt. 1893, p. 142*).—The results of 6 trials of setting milk in shallow pans for 24 and 36 hours showed "no gain in creaming by allowing the milk to stand 36 hours as compared with 24."

Milk set in pans in warm vs. cool temperature, H. H. DEAN (*Ontario Agl. Col. and Exptl. Farm Rpt. 1893, pp. 143, 144*).—In each of 13 trials made in November one portion of milk was set in pans in the basement of the dairy where the temperature ranged from 43 to 50° F., and the other portion was set in the dairy where the temperature ranged from 48 to 75°.

"In 13 trials where the average temperature of the milk when skimmed was 56°, the per cent of fat in the skim milk was 0.38; and in 12 trials where the average temperature was 46 when skimmed, the average per cent of fat in skim milk was 0.28. Except the first, second, eleventh, and twelfth trials, the colder temperature gave the best results."

Cream measurement on deep pail after setting 12 to 48 hours, H. H. DEAN (*Ontario Agl. Col. and Exptl. Farm Rpt. 1893, pp. 142, 143*).—Nine trials are reported in which separate portions of milk were allowed to stand in deep pails for 12, 24, 36, and in one case, 48 hours before creaming, the object being to observe the shrinkage in volume of cream. "The average shrinkage appears to be from one eighth to one fourth inch during the second 12 hours and about one eighth inch for each 12 hours after that up to 48 hours."

Creaming quality of different cows' milk, H. H. DEAN (*Ontario Agl. Col. and Exptl. Farm Rpt. 1893, p. 141*).—The loss of fat in skim milk from 12 different cows "ranged all the way from nothing to 0.66 per cent."

Report on separators, H. C. WALLACE (*Iowa Sta. Bul 25, pp. 32–38*).—The results are summarized of tests made by dairy students during the course of their instruction of Alpha, Danish-Weston, Jumbo, and Russian separators. The average results are given as follows:

Summary of tests of separators.

Name.	Number of trials.	Temperature of milk.	Speed	Fat in cream.	Fat in skim milk
				Per cent.	*Per cent.*
Alpha	61	82.6	5,683	31.00	0.06
Danish-Weston	52	82.0	5,340	25.58	0.07
Jumbo	22	84.0	7,458	22.00	0.22
Russian	54	83.4	7,461	27.50	0.08

A report by G. W. Bissell on the power required for running the separators and for running 2 churns and 2 butter workers is appended. The horsepower required for separating 1,000 lbs. of milk per hour was: Alpha, 0.362; Danish-Weston, 0.583; Jumbo, 1.051; and the pounds of steam required for separating 1,000 lbs. of milk per hour with the Russian was 63.

Experiments with the Johansson butter extractor, R. GRIPENBERG (*Mustiala Agl. College Rpt. 1892, pp. 22–29*).—In 1891 8 trials were made, from 942 to 1,540 lbs. of milk per hour being run through the extractor in different trials. The average fat content of the skim milk in case of unpasteurized milk was 0.38 per cent, and in case of pasteurized milk 0.29 per cent. The buttermilk in the former case contained 1.59 per cent of fat and in the latter 1.40 per cent.

Nine trials are reported for 1892. The milk run through per hour varied from 858 to 1,870 lbs. The average per cent of fat in skim milk was 0.49 per cent, and in the buttermilk 2.94 per cent. The average number of pounds of milk required per pound of butter was 33.4; milk from the same source, separated by means of an Alpha A No. 1, or a Danish-Weston separator, the cream being churned in the ordinary way, produced 1 lb. of butter on an average from 24.7 lbs. of milk.

The buttermilk obtained in the extractor method contains from 2.4 per cent of fat and the wash water from 0.5 to 2.5 per cent. It is

directed to run this through a second time, but the quantity which thus has to be returned varies from 17 to 30 per cent of the total quantity of milk, or in the worse case nearly one third of the milk.—F. W. WOLL.

Amount of butter produced by two groups of cows, H. H. DEAN (*Ontario Agl. Col. and Exptl. Farm Rpt. 1893, p. 142*).—Two cows whose milk averaged 4.89 per cent of fat gave 139 lbs. of milk in 3 days, from which 8.38 lbs. of butter was made. Three cows whose milk averaged 2.84 per cent of fat gave 199 lbs. of milk in 3 days from which 6.78 lbs. of butter was made. The loss of fat in skim milk was a trace in the first case and 0.26 per cent in the second case.

Calculation of butter yield, H. H. DEAN (*Ontario Agl. Col. and Exptl. Farm Rpt. 1893, p. 152*).—Calculating the yield of butter by adding one tenth to the fat shown by test showed in the case of one cow 17.62 lbs. of butter, while the amount actually made was 17.56 lbs.; and in another case the calculated yield was 21.47 lbs. and the actual yield 20.81 lbs. The author considers this a fair rule for calculating the probable yield of butter.

The ripening of cream by artificial cultures of bacteria, H. W. CONN (*Connecticut Storrs Sta. Rpt. 1893, pp. 43–68*).—Experiments are reported in ripening pasteurized cream with pure cultures of 14 species of bacteria isolated from ripened cream found at creameries in Connecticut or from milk, and with a number of other cultures obtained from Europe. The characteristics of these species are described, and also the method of making the experiments. In all, over 150 separate experiments were made. The appearance, reaction, odor, and taste of the ripened cream are noted, and the quality of the butter made from the same.

"Several points of general interest have been shown by the experiments above given, which may be summarized here. In the first place, it has been proved in all cases that a temperature as high as 35° C., even for a few hours, is almost sure to overripen the cream and produce bad butter. Moreover, it was found that pasteurized cream, even though not subsequently inoculated, would become ripened in 24 hours at this temperature, indicating, of course, that the spores left in the cream developed rapidly enough at that temperature to produce marked results. Evidently a temperature of 35° can not be used for ripening in such experiments. Temperatures of 28 and 23°, however, could be used for 24 hours without difficulty, the uniformity of the experiments at this temperature showing that the cream was ripened chiefly by the artificial culture inoculated. At the temperature of 20° the ripening could be continued for 2 days without trouble, and in no case was an overripening produced in this time with any of the pure cultures used. . . .

"[The results where the same cream was ripened with different cultures] plainly show the difference in the butter of different species of bacteria and, in addition, indicate that the method of experiment was rigid enough to obtain at least approximate results in all cases.

"Another point brought out clearly in these experiments was the effect of the washing of butter. Nearly all of the flavor produced by the ripening of the cream was in the buttermilk, and the taste of the butter was very much more prominent without thorough washing than it was after such washing. If the butter was

washed long enough all of the aroma would be washed out, while without any washing at all the taste was most prominent. The butter aroma is, then, not due to changes in the fat, but to some other constituents of the cream. . . .

"The total result of these experiments, however, has been to indicate that the effect upon the flavor of butter, while noticeable, is not so striking as was at the outset expected. At the same time the effect was sufficient to make the differences between the fine, delicately flavored butter and the unpleasant, strong-tasting butter which result from an improper ripening; in other words, the differences between the very highest quality of butter and that of an inferior grade.

"Another point of much significance was noted. Of the large variety of species of bacteria found in ripening cream the number which produce poor butter is very small. Among the 20 species already experimented with only 3 produced strikingly bad effects, while all the rest gave good butter or had no marked influence. This is a matter of considerable importance as bearing upon dairy interests. It indicates that no particular species of bacteria is needed to produce a good aroma, but that nearly all of the species liable to get into the cream under normal conditions will give moderately good results. Some, indeed, are better than others for the purpose, and some really produce injurious effects, but the majority of species are either directly advantageous or neutral in their action. It must be remembered, however, that the source of these organisms was cream from first-class creameries, where the beneficial species must be supposed to outnumber the injurious ones. What result would have been obtained if a lot of cream from an inferior dairy had been used as a starting point can not be stated, but the result remains that good conditions may be depended upon to produce favorable varieties of bacteria in abundance.

"Somewhat akin to the above is the general observation that no single species produced a typical ripening of cream, or the usually expected flavor in the butter. Although many of them produced excellent butter, yet in every case the verdict would be given that the flavor was not exactly that of normally ripened butter. This is not to be wondered at, for it is hardly to be expected that any one species would produce the same result as that produced by many species growing together. Experiments with combinations of species have therefore been undertaken, but the results are not yet complete.

"Most of the species experimented with produced an alkaline reaction, the reason being that a large part of the species isolated from ripening cream showed this peculiarity. The few acid-producing species isolated did not produce so good effects on the butter as the alkaline-producing species. Further experiments with acid-producing species are needed, however."

In the report of the director of the station it is stated that—

"One species of bacteria for ripening cream has been furnished to 3 creameries. At the time of the present writing the experience with it has covered a period of several weeks in each of 2 and nearly 4 months in 1 of the creameries—that in Cromwell, Connecticut. The managers report most gratifying results. Those with the longest experience are the most enthusiastic. In the Cromwell creamery the use of a culture furnished by Prof. Conn has greatly improved the quality of the butter."

Creameries and infectious diseases, J. J. WELPLY (*Lancet, 1894, pp. 992–996*).—A case is detailed in which typhoid fever was conveyed through a creamery to its patrons by drinking the skim milk. A farm on which there had been a case of typhoid fever furnished milk to the creamery. This milk was of course mixed with that of the other patrons and separated, the patrons taking the mixed skim milk home. Out of about 24 farms dealing with the creamery 12 suffered with the disease, while all the farms in that district not dealing with it—about 180—escaped except 2, and the infection was indirectly conveyed to these.

The persons attacked had been in the habit of drinking the skim milk. Of the 12 farms which escaped the epidemic, on some the skim milk was not used without boiling, and on the others it was given only to young cattle and pigs. Farmers in the infected district who carried their milk to another creamery were not attacked. Of 23 cases which occurred in the town in the district, 19 used skim milk and the remaining 4 had milk from the infected dairies. In all—in the town and rural district—there were 61 cases of typhoid fever, "every one of which was capable of being easily traced back to the imported one. Fifty-two contracted the disease directly through the creamery, and the remaining 9 indirectly by means of food or milk from dairies which became infected secondarily."

To account for the infection of the milk from the first case the author found that the person attacked with the disease was nursed by one of the dairy maids, "and in several of the dairies subsequently visited I found the dairy maids acting in the dual capacity of milkers and nurses; in fact, I saw sufficient to convince me that if the infection once got on the hands it had every opportunity of eventually reaching the milk."

In regard to the germs of the disease the author says:

"The typhoid bacillus measures about the ten-thousandth part of an inch, and Dr. Klein has demonstrated that it is capable of doubling its numbers in 30 minutes. A streak of these, therefore, on the finger, a quarter of an inch in length and of microscopical width, will contain about 2,500 germs, and if they find their way into the milk they will number about 40,000 at the end of 2 hours—quite sufficient to spread disease broadcast through all the dairies around any butter factory."

The author emphasizes the liability of spread of infectious diseases, as scarlet fever, diphtheria, cholera, etc., through the medium of creameries, where even a single patron is careless, and concludes that "wherever a creamery exists there a sanitary policeman should secure the proper management of the dairies." He cites the stringent rules of the Denmark creameries, imposing fines upon any patron delivering milk during an outbreak of an infectious disease in his family or stock.

Experiments in cheese-making, H. H. DEAN (*Ontario Agl. Col. Bul. 95, pp. 3–7*).—A report is given of a number of experiments in making cheese during May and June. In each experiment 2 lots of 300 lbs. of milk each were used, one lot containing milk with less than 3.6 per cent of fat and the other lot of milk with a higher percentage of fat. The highest per cent was 4.4 and the lowest 3.3. The method of making the cheese is described in detail and the results are tabulated. During May the richer milk averaged 3.8 per cent of fat and the poorer milk 3.48 per cent. The former gave 1 lb. of cured cheese from 10.77 lbs. of milk and the latter 1 lb. from 11.46 lbs. The amount of green cheese made from 1 lb. of fat in the richer milk was 2.59 lbs. and in the poorer milk 2.68 lbs. The average percentage of fat in the whey was 0.26 and 0.25, respectively. In the June experiment the richer milk averaged 4.18 per cent of fat and the poorer milk 3.6. One pound of cured cheese

was made from 9.79 lbs. of the former milk and 10.59 lbs. of the latter. The average amount of green cheese produced from 1 lb. of fat in the richer milk was 2.6 lbs. and in the poorer 2.8 lbs. The percentage of fat in the whey was 0.19 in both cases. The cured cheese was scored by competent judges.

The May cheese from the richer milk scored 83 points and that from the poorer milk 84 points; the June cheese from the richer milk scored 91 points and that from the poorer milk 93 points. The cheeses scoring the highest number of points in May and June were made from milk with 3.2 and 3.4 per cent of fat, respectively.

"It is yet too soon to draw definite conclusions from our work, but so far it would indicate:

"(1) An increased percentage of fat in the milk gives an increased yield of cheese, though not in the same proportion.

"(2) That a pound of butter fat in milk ranging from 3.2 to 3.7 per cent will make more cheese than a pound of fat in milk ranging from 3.6 to 4.5 per cent of fat.

"(3) That there need not necessarily be more loss of fat in whey from rich milk up to 4.5 per cent fat than from poor milk, though we did notice a little more 'grease' on the hoops, press, and shelves from the rich-milk cheese (4.5 per cent fat).

"(4) That milk containing the same per cent of fat does not always give the same yield of cheese, especially when comparing one day with another or one month with another. April 30, 300 lbs. of 3.9 per cent milk made 28¼ lbs. cured cheese; May 1, same quantity and quality of milk made 27½ lbs.; June 9 it made 28¼ lbs. May 1, 300 lbs. of 3.60 per cent milk made 24½ lbs. cured cheese; May 2, 27½ lbs.; June 6, 28 lbs. May 4 both vats tested 3.7 per cent and each made 27½ lbs. cured cheese. June 8, 3.7 per cent milk made 28¾ lbs. cheese."

The difference between the payment for milk by weight and by test is illustrated in a table. The author is inclined to believe that payment for milk by test at cheese factories works an injustice to the patron furnishing the poorer milk and gives the patron furnishing rich milk more than his just share of the proceeds.

"To overcome this difficulty it has been suggested by one of our prominent young dairymen of western Ontario to add 1 per cent to each man's butter-fat reading. For instance, a patron who sends an average of 4 per cent milk, call his test 5 per cent; one who sends 3 per cent milk, call it 4; and so on with all the tests. When this was first suggested I was not favorably inclined toward the plan; but the results as seen in the table would seem to indicate that adding 1 or even 2 per cent to the fat readings in these tests is more nearly correct than paying by weight of milk or by the fat alone."

Report on special research into the processes of Cheddar cheese-making, F. J. LLOYD (*Bd. Agr. Rpt. Distrib. Grants for Agl. Education in Great Britain 1893–'94, pp. 113–127*).—An account of practical trials in making cheese in a district where it was popularly believed good cheese could not be made. Great difficulty was experienced, upon which analysis of the soil and the pasture grasses threw no light. The trouble was found to be a bacteriological one, and three taints were detected in the curd; *i. e.*, a fecal odor, an "aldehyde" odor, and spongy curd. These were studied and numerous bacteria found, but the forms responsible for the taints were not isolated. The evil effects

of these were overcome to considerable extent by allowing the curd to become unusually sour before grinding.

The cause of blue spots in cheese, T. J. KLAVERWEIDEN (*Milch Ztg., 23 (1894), No. 34, pp. 540–542; No. 35, pp. 558–560*).—Considerable trouble was experienced in Holland with cheese becoming streaked or spotted with blue, and the author made an investigation of the matter which soon showed that the trouble was not due to bacteria primarily. Qualitative analysis of the spotted cheese showed the presence of iron, but no copper was found. Normal cheese gave a slight reaction which was at first misleading, but afterwards proved to be due to phosphates.

Quantitative determinations were then made by Oudeman's method, which showed the following percentages of iron in different cheese:

	Per cent
Cheddar cheese	0.0092
Clear Gouda cheese	0.0112
Blued Gouda cheese No. 1	0.0400
Blue specks from the latter	0.6809

This method is said to sometimes give too high results. Another method (formation of iron alum and titration with hyposulphite in presence of potassium iodid) gave the following amounts of iron:

	Per cent.
Blued cheese No. 2	0.0094
Blued cheese No. 3	0.0080
Clear cheese	0.0046

By this method the blued Gouda cheese contained 0.0085 per cent of iron, and the blue specks from the same 0.14 per cent.

The presence of iron was also clearly demonstrated under the microscope, and the author concludes the blue coloration is due to particles containing iron, which, however, appear often to be accompanied by some other foreign substance. Lengthy studies were made to find how these materials got into the milk or cheese. These led to no definite conclusions, but the author suggests that the iron may come from using ferruginous water, or rusty utensils, or may be due to bacteria, *Crenothrix kühniana*, which takes iron up from water and afterwards deposits it as spots of iron oxid. The time of greatest prevalence of this microörganism, August and September, agreed in general with the occurrence of this cheese fault. Not a single Cheddar cheese was found which turned blue, and as the iron content of Cheddar cheese was low the author regards this as supporting his conclusion that iron is the cause of the fault.

Outlines of dairy bacteriology, H. L. RUSSELL (*Madison, Wis.: Published by the author, 1894; pp. VIII+186*).—This is a short handbook intended primarily for students in dairy schools. It attempts to present the principles of the science of bacteriology in their relations to dairy problems, and to explain in a practical way the methods of controlling the activity of bacteria so as to utilize them to advantage to the dairy, and to avoid the evil results which their unchecked growth may cause. Of the three parts of the book the first treats of bacteria in general, their structure and form, function and distribution; the second of the relation of bacteria

to milk, the sources of infection and prevention, the fermentations of milk, preservation of milk, and disease producing bacteria in milk; and the third, of the relation of bacteria to milk products, including their rôle in butter-making and cheese-making, abnormal changes in butter and abnormal fermentations in cheese.

The treatment is clear and concise, and the technical terms necessarily used are defined in a glossary at the end of the book. Illustrations are entirely omitted, "on account," as the author says, "of the general unsatisfactory nature of the ordinary processes used in reproducing bacteria."

Observations on the dairy industry in the United States and Canada, J. SIEDEL (*Wahrnehmungen auf milchwirthschaftlichem Gebiete in den Vereinigten Staaten von Nord-Amerika und Kanada. Darmstadt: A. Bergsträsser, 1894, pp. 207, figs. 45*).—This book gives an interesting account of what the author saw of American dairying on his travels in the United States and Canada. The dairy work of the experiment stations, the management of private dairies and of coöperative creameries and cheese factories, and exhibits of improved dairy machinery at the World's Fair are described in detail. The butter markets, dairy boards of trade, and milk supply of cities also receive attention.

In the chapter on "What is America doing for the advancement of dairying?" an account is given of the experiment-station system of this country, the dairy schools, and the State dairy commissions and associations. The author finds much to commend and much which he believes might be imitated in Germany with advantage.

Encouragement of the dairy interests of North Carolina through the medium of State fairs, F. E. EMERY (*North Carolina Sta. Bul. 102, pp. 227–235*).—Remarks on the improvement of dairy stock, a report of the test of dairy cows at the State Fair in 1893, and a plan for a test of dairy cows at the State Fair in 1894. The test in 1893 included 10 cows of various breeds. The percentage of fat found in the milk ranged from 1.4 (native) to 8.4 (Jersey).

The progress of the dairy industry in North Carolina, H. B BATTLE (*North Carolina Sta. Bul. 101, pp. 219–224*).—A paper discussing this question with the aid of statistics. It is shown that during the 10 years from 1880–'90 the number of improved milch cows, the total yield of milk, butter, and cheese, and the average yield per cow have all materially increased, and that the number of butter factories in the State is on the increase.

Dairying in Victoria (*Jour.* [*British*] *Bd. Agr., 1 (1894), No. 1, pp. 20, 21*).—Statistics of the dairy industry in Victoria and an account of what is being done by bonuses and otherwise to encourage it.

Bacteria and dirt in milk, L. SCHMELCK (*Landmandsblade, 27 (1894), pp. 530, 531; Mälkeritid., 7 (1894), p. 548; abs. from Rev. Internat. Falsif., 1894, July 15.*

Creaming and aërating milk, H. H. WING (*New York Cornell Sta. Rpt. 1892, pp. 113–142*).—A reprint of Bulletin 39 of the station (E. S. R., 4, p. 361).

Ludlow's hand milk centrifuge (*Deut. landw. Presse, 21 (1894), No. 79, p. 753, figs. 4*).

Some remarks on Babcock's method of fat determination, F. W. WOLL (*Tidskr. norske Landbr., 1 (1894), pp. 285–292*).—A short historical sketch, with general remarks bearing upon the application of the method in creameries and private dairies.—F. W. WOLL.

Manufacture of butter (*Bol. Nac. Agr., 18 (1894), No. 15 and 16, pp. 359–365*).

On coöperative creameries, G. GROTENFELT and A. GRANSTRÖM (*Aabo: Imperial Finnish Agl. Soc., 1893, pp. 60*).—A prize essay.

Some Fyen coöperative creamery accounts, B. BÖGGILD (*Mälkeritid., 7 (1894), pp. 517–527*).

A Swedish coöperative creamery (*Nord. Mejeri Tidn., 9 (1894), pp. 365, 366*).

Trials of churns at Cambridge, R. E. CRUTCHLEY (*Jour. Roy. Agr. Soc. England, ser. 3, 5 (1894), No. 19, pp. 487–497, dgms. 2, figs. 4*).—The time and power required by each churn, the per cent of butter to cream, and other data are given.

Swedish butter exhibitions (*Tidskr. Landtmän., 15 (1894), pp. 640, 641, 678, 679,*

750, 751).—Accounts of the eleventh and twelfth exhibitions at Gothenberg, and the twenty-fourth, twenty-fifth, and twenty-sixth exhibitions at Malmö.

The manufacture of good skim-milk cheese, N. C. JUEL (*Mälkeritid., 7 (1894), pp. 539–542*).

The fat content of centrifugal skim-milk cheese, B. BÖGGILD (*Mälkeritid., 7 (1894), pp. 503–505*).

Experiments in cheese-making, H. H. DEAN (*Ontario Agl. Col. and Exptl. Farm Rpt. 1893, pp. 147, 148*).—Brief mention of work in this line.

Traveling dairies, H. H. DEAN (*Ontario Agl. Col. and Exptl. Farm Rpt. 1893, pp. 153–159*).—An account of the work done in this direction during 1893.

"During this year there have been 2 dairies on the road. . . . During the time which [one of these] was on the road it traveled some 1,750 miles, held 140 meetings, and 1,944 samples of milk were tested. Addresses were given at all these meetings on various dairy topics, but most stress was laid on the importance of having good cows, proper and abundant feed and water, and the various steps in handling milk until it was put up in a neat, attractive form, ready for market, were fully explained. Thousands of "Hints on butter-making" have been distributed. The work as a whole has been appreciated by those for whose benefit it was established, and no doubt great good will come from it. . . .

"[With the other] we traveled altogether during the season 2,409 miles, held 132 meetings, delivered the same number of lectures, tested 2,350 samples of milk, of which 202 were buttermilk and 51 were skim milk. We churned 3,855 lbs. of cream which made 987 lbs. of butter, or about 3.92 lbs. of cream required to make 1 lb. of butter. . . .

"The whole province has now been covered except the counties of Peel and Halton. Every farmer has had an opportunity of attending one or more of these daily assemblies, as they were so arranged that all might have the advantage of a practical lesson in butter-making, and hear the main points connected with dairying discussed."

Dairy frauds, H. H. DEAN (*Ontario Agl. Col. and Exptl. Farm Rpt. 1893, pp. 171–173*).—Two tests of "Chase's Butter Increaser," with 31½ and 22 lbs. of cream, respectively, showed a slightly smaller yield with than without it, and the same percentage of fat in the buttermilk.

Mention is also made of "Thurston's New Butter Process" and "Gastric Soda," for both of which extravagant claims are made, but no tests reported.

Lactola, an artificial product from skim milk, C. MORFIT (*English Patent; Jour. Soc. Chem. Ind., 13 (1894), No. 9, p. 898*).—The inventor proposes to make up for the deficiency of fat in skim milk by adding cotton-seed oil. One hundred gallons of skim milk is boiled in a vacuum pan with 50 to 200 lbs. of white sugar until evaporated to ⅓ or ¼ of its bulk and then transferred to another pan, where 1½ to 2 oz. of refined cotton-seed oil is added, and the whole stirred until thoroughly blended. This artificial milk is termed lactola.

TECHNOLOGY.

Sugar production in Egypt, F. C. PENFIELD (*U. S. Consular Rpt. 1894, Sept., pp. 38–44*).—A résumé of the history of sugar culture in Egypt, with statistics of the industry at present, and remarks on the growing and crushing of the cane and refining and exporting of the sugar. Tables are given showing the gross yields for several years and averages per acre, both of cane and of sugar and molasses obtained. Figures obtained from one of the large factories show an average of 18¾ tons of cane per acre, producing in 1892 10.69 per cent of sugar

and 2.3 per cent of molasses. The price of the first-grade sugar averages $3 per cwt., and in 1892 the output was 68,064 tons of sugar, 55,128 tons being first grade. The proposed construction of a vast reservoir at Assouan, on the Upper Nile, is commended, to supply water to the planters in the drought of summer.

The use of pure yeasts in cider-making (*Ind. Lait., 19 (1894), No. 32, pp. 254, 255*).

Vegetable fibers, A. ROSOLL (*Jahresber. nieder österr. Landw. oberrealschule, Wiener Neustadt, 29 (1894), pp. 15, figs. 5; abs. in Bot. Centbl., 60 (1894), No. 7, pp. 215, 216*).

Improvements in apparatus to be employed in the cleaning of cotton seed (*Jour. Soc. Chem. Ind., 13 (1894), No. 9, p. 893*).

AGRICULTURAL ENGINEERING.

The progress of coöperative drainage in Rhine Hesse, LUEDECKE (*Ztschr. landw. Ver. Hessen, 1894, No. 41, pp. 336, 337; No. 42, pp. 345, 346*).

Windmill irrigation, K. H. EGGLESTON, Jr. (*Cult. and Country Gent., 1894, Nov. 8, p. 805*).

The measurement and division of water, L. G. CARPENTER (*Colorado Sta. Bul. 27, pp. 42, figs. 7*).—This is a third revised edition of Bulletin 13 of the station (E. S. R., 2, p. 396).

An electric plow, F. BRUTSCHKE (*Deut. landw. Presse, 21 (1894), No. 89, pp. 834, 835, fig. 1*).

Miscellaneous implements exhibited at Cambridge, T. STIRTON (*Jour. Roy. Agr. Soc. England, ser. 3, 5 (1894), No. 19, pp. 466–487, figs. 12*).—Notes on the work of the manure spreader, hay presses, weighbridge, potato digger, plows, sheep dipping apparatus, and other implements.

New dairy building, H. H. DEAN (*Ontario Agl. Col. and Exptl. Farm Rpt. 1893, pp. 174, 175, figs. 2*).—Plans of the new dairy building at the Ontario Agricultural College.

STATISTICS.

Report of director of Connecticut Storrs Station (*Connecticut Storrs Sta. Rpt. 1893, pp. 8–16*).—This includes general remarks on the lines of work pursued during the year, including the examination of food stuffs made under the supervision of the director of the station as a member of the jury of awards at the World's Fair, and investigations with the bomb calorimeter and the respiration calorimeter.

"Hitherto the only satisfactory bomb calorimeter has been that of Berthelot, but its great cost, $1,000 or more, which is due to the large quantity of platinum required for its construction, has prevented its general use. With the aid of Prof. Hempel, of Dresden, I have succeeded in obtaining a bomb calorimeter which costs not more than $100 or $200, and proves quite satisfactory. The effort is now being made to devise one which shall be less expensive."

Report of treasurer of Connecticut Storrs Station (*Connecticut Storrs Sta. Rpt. 1893, pp. 6, 7*).—This is for the fiscal year ending June 30, 1893.

Sixth Annual Report of Georgia Station (*Georgia Sta. Rpt. 1893, pp. 107–111*).—A brief review of the work of the year, list of bulletins published, and a financial statement for the fiscal year ending June 30, 1893.

Sixth Annual Report of Indiana Station (*Indiana Sta. Rpt. 1893, pp. 33*).—This includes short reports by the director, chemist, botanist, veterinarian, horticulturist, and agriculturist, some of which are mentioned elsewhere, and a financial statement for the fiscal year ending June 30, 1893.

Annual Report of New York Cornell Station for 1892 (*New York Cornell Sta. Rpt. 1892, pp. 483*).—This contains short reports by the director; treasurer for the fiscal year ending June 30, 1892; the chemist, botanist, and arboriculturist; cryptogamic botanist and plant pathologist; entomologist, agriculturist, and horticulturist; a reprint of bulletins 38 to 49, inclusive; and a detailed statement of the receipts and expenditures of the station for the fiscal year ending June 30, 1892.

Sundry investigations of the year (*New York Cornell Sta. Rpt. 1892, pp. 395–460*).—A reprint of Bulletin 49 of the station (E. S. R., 4, pp. 802, 811, 817, 821, 836, 83).

Report of the Statistician (*U. S. Dept. Agr., Division of Statistics Rpt. 119, Sept., 1894*).—The subjects treated are as follows: Crop report for September; number and condition of stock hogs; notes from reports of State agents; tabulated data giving the average condition of crops September 1, 1894; urban population in the South; notes on foreign agriculture, and transportation rates.

Proceedings of the seventh annual convention of the Association of American Agricultural Colleges and Experiment Stations (*U. S. Dept. Agr., Office of Experiment Stations Bul. 20, pp. 98.*)—This is the proceedings of the convention held at Chicago, Illinois, October 17–19, 1893. In addition to the general business and discussion the following papers are given: Agricultural investigation at Rothamsted, England, Sir J. H. Gilbert; How can we increase the attendance of station officers at our annual conventions? C. E. Thorne; Shopwork instruction at the Iowa State College of Agriculture and Mechanic Arts, C. W. Bissell; Technical education, C. W. Hall; The manual training and the apprenticeship system, C. R. Richards; Mechanical drawing in technical schools, J. J. Flather; The Solandi printing, B. D. Halsted; and Field observations with fungi, B. D. Halsted.

A short account of this convention has been given (E. S. R., 5, p. 274).

Report of the convention of German Experiment Stations, 1894 (*Chem. Ztg., 18 (1894, No. 81, p. 1565; No. 82, pp. 1588, 1589)*).

Murrumbidgee Experimental Farm, North Wagga Wagga, New South Wales, J. COLEMAN (*Agl. Gaz. N. S. W., 5 (1894), No. 9, pp. 631–638*).—General notes on the location of the station and on crops grown in 1893.

MISCELLANEOUS.

Report of the convention of the Association of German Natural Scientists and Physicians, 1894 (*Chem. Ztg., 18 (1894), No. 79, pp. 1514–1519; No. 80, pp. 1534–1543; No. 82, pp. 1589–1597*).

Agriculture in Germany and America, M. MAERCKER (*Landw. Kalender for 1895, pp. 51–87*).

Recent modes of agricultural inquiry, W. MAXWELL (*Proc. Ses. State Agl. Soc. Louisiana, 1894, pp. 42–51*).

Typical farms in East Anglia, R. BRUCE (*Jour. Roy. Agr. Soc. England, ser. 3, 5 (1894), No. 19, pp. 497–530*).—Reports on the number of farms, giving the expenditures, receipts, number and kind of stock kept and crops grown, and methods pursued.

New South Wales wool exhibit at the World's Columbian Exposition, H. G. KITTRIDGE (*Tech. Quart., 1894, April, pp. 4–20*).

Report of public measures for the advancement of agriculture in Norway during 1893 (*Kristiania: 1894, pp. LVIII + 391, with appendices*).

NOTES.

Nevada Station.—F. Stadtmuller has been appointed assistant chemist.

New Hampshire Station.—As a result of an examination by the tuberculin test, the station herd has been found affected with tuberculosis. Out of a herd of about 60, 9 have been condemned, and of these 3 have been slaughtered. The condemned animals have been separated from the rest of the herd, and the test will be applied again in about 6 weeks. The milk from these animals is to be used for experimental purposes.

Papers presented before the Botanical Club of the American Association for the Advancement of Science.—The following informal papers were presented before the Botanical Club during the meeting of the American Association for the Advancement of Science at Brooklyn, N. Y., August 16–21, 1894: The germination of the macrospores of *Marsilia vestita*, C. E. Bessey; Tannin as a mordant for staining cell membranes, E. F. Smith; Tannin as a mordant for staining protoplasmic structures, F. C. Newcombe; The use of measures in the identification of grasses, W. J. Beal; The decrease of oat smut in Vermont, L. R. Jones; Formalin as a preserving fluid, B. T. Galloway, E. F. Smith, and G. H. Hicks; The check list of plants of the Northeastern States, N. L. Britton; The bacterial diseases of cucumbers, E. F. Smith; Extreme decapitalization, C. E. Bessey: A *Hæmatococcus* for class demonstration of motile gametes, L. R. Jones; Sporangial trichomes on certain ferns, E. J. Durand; The significance of stipules from the standpoint of paleobotany, A. Hollick; *Eustichia norvegica* fruiting in Wisconsin, C. R. Barnes; Gonidial chains of *Entyloma flœrkeæ*, J. J. Davis; Solandi printing of variegated leaves, B. D. Halsted; A better pronunciation of botanical terms, C. E. Bessey; The peach-spotting fungus as a leaf parasite, B. D. Halsted; Development of *Olipidium* sp., E. J. Durand; A peculiar discoloration of the pæonia leaf, B. D. Halsted; A simple method of making pure cultures of fungi, E. F. Smith; The work of the botanical seminar of Nebraska, C. E. Bessey and R. Pound; The killing of young pear shoots by excessive transpiration, M. B. Waite; and Staining of the flagella of bacteria, M. B. Waite.

Botanical papers read at the meeting of the American Association for the Advancement of Science.—The following papers were read before section G (botany), at the meeting of the American Association for the Advancement of Science, Brooklyn, N. Y., August 16–21, 1894: The growth of radishes as affected by the size and weight of the seed, B. T. Galloway; Movement of gases in rhizomes, K. Golden; The sugar maples of Central Michigan, W. J. Beal; Some affinities among *Cactaceæ*, J. M. Coulter; Simplification and degeneration of structure in angiosperms, C. E. Bessey; Regulatory growth of mechanical tissue, F. C. Newcombe; Further studies in the relationship and arrangement of the families of flowering plants, C. E. Bessey; The watermelon disease of the South, E. F. Smith; Preliminary note on the relation between the sterile and fertile leaves of *Onoclea*, G. F. Atkinson; *Lophopappus*, a new genus of mutisiaceous *Compositæ*, and *Fluckigeria*, a new genus of *Gesneriaceæ*, H. H. Rusby; Preliminary note on the swarm spores of *Pythium* and *Ceratiomyxa*, G. F. Atkinson; A revision of the genus *Scouleria*, E. G. Britton; Evidence as to the former existence of large trees on Nantucket Island, B. G. Wilbur; Notes on the primary foliage and leaf scars of *Pinus rigida*, N. L. Britton; Notes on *Chalara paradoxa*, C. E. Bessey; A hybrid among mosses, E. G. Britton; Notes on a root rot

of beet, B. D. Halsted; On *Torrya* as a generic name, N. L. Britton; Notes on the genus *Eucalypta*, E. G. Britton; On the growth of forest trees as illustrated by corner marks 107 years old, J. Hotchkiss; and Species of *Taphrina* parasitic on *Populus*, Mrs. F. W. Patterson.

In addition the following were read before the joint meetings of Sections F and G: Some interesting conditions in wood resulting from the attacks of insects and woodpeckers, A. D. Hopkins; Work of the Indiana biological survey, A. W. Butler; Relation of age of type to variability, L. H. Bailey; The struggle for existence under cultivation, L. H. Bailey; and Limits of biological experiments, M. Miles.

EXPERIMENT STATION RECORD.

VOL. VI. No. 6.

Garden herbaria, or collections of specimens illustrating the species and varieties of cultivated plants, have been begun at a few of the experiment stations, notably under direction of Prof. L. H. Bailey, at the station connected with Cornell University. The object of these herbaria is to furnish a scientific basis for the study of varieties by providing a fund of exact information for their identification, and, what is of vastly greater importance, for the guidance of experimenters who are seeking to improve them. Such collections help to show the relationships of varieties and indicate features to be elaborated and improved, and others to be discarded. It is an acknowledged and regretted fact that in the study and comparison of different varieties of plants, and particularly of fruits and vegetables, a decided drawback sometimes exists in the absence of accurately determined specimens, and even of precise descriptions or figures. It may occur that some of the varieties considered have been misidentified, or that the plants under observation vary more or less from the original stock, and in various ways nomenclatural and other errors may inadvertently creep in, affecting the value of the results reached, and possibly rendering them absolutely misleading. A remedy for such a condition of things exists in the garden herbaria, which have been found almost invaluable aids in varietal work.

The scope of these collections may vary, but should be as extensive as practicable. They should primarily comprise dried specimens of the different varieties cultivated, and in the case of annuals should be enlarged each year by the addition of plants grown from seed. Not only should typical representatives of the varieties be shown, but also marked variations should be preserved. Where the whole plant can not be pressed, leaves from different portions and sections of the stem and branches may be selected. In the case of fruit trees, for instance, leaves should be saved from new shoots of the year's growth, and also from fruiting branches. The blossoms, in bud and full bloom, should be carefully pressed, so as to retain the relations of the various parts. Small packets of the seed, both green and ripe, should not be neglected, and where the plan is available dried fruits may be kept. Plas-

ter or wax casts of the fruit, made at different stages of maturity, are important, as they accurately preserve the size and form and a record of the changes during growth. A mold in plaster of Paris can be made of most fruits with comparative ease, and the resulting cast can be colored to life or not, at the discretion of the curator. For many varieties of orchard fruits a record of the successive stages of growth is of especial value, as for example for peaches, some varieties of which change form and size remarkably in the last week of maturity. In like manner casts may be made of the roots for root crops, and also in other cases. In some instances specimens of the plants, fruits, and roots may be preserved in alcohol, thus rendering them available for study.

Photography is of the utmost value, and should be employed freely. The plants should be photographed while growing, and at different periods of growth, particularly those individuals afterwards to be pressed for the herbarium. Fruit trees may be photographed in the nursery rows when one or two years old, and afterwards in the orchard, both before reaching a fruiting age, and later to show the change in form produced by fruit bearing. Frequently the growing fruit may be photographed to show the manner of growth and relation to the plant bearing it, and views may also be made of the fruit cut transversely and longitudinally to show its structure, which is so frequently a characteristic point. When advantageous and possible to do so, color sketches may be made, and a point to be carefully observed is the taking of copious notes during the growing season, and particularly concerning the time of blooming and fruiting.

By the employment of such methods and the preservation of material in this manner accurate identifications can be made, an absolute record kept of progress toward improvement, and variations noted for study and experiment. If the collector keeps steadily in view the main object of his work, which is to obtain a permanent and visible record of the different forms of cultivated plants that may lead to the discovery of some improved system of classification or some general principles governing improvement of varieties, he will not only have much greater satisfaction in his work than usually attends the testing and identification of varieties, but will also help to lift the varietal work of the horticulturist from its present dead level of routine and empiricism.

NITRIFICATION IN ARABLE SOIL.[1]

P. P. DEHÉRAIN.

EXCESSIVE NITRIFICATION IN SOILS SENT TO THE GRIGNON STATION.

Early in 1891 a sample of soil collected on the estate of M. Fizeau, near La Ferté-sous-Jouarre (Seine-et-Marne), was sent to the Grignon Station. On analysis this soil was found to contain, per kilogram, total nitrogen, 1.96 gm.; total phosphoric acid, 1.08 gm.; phosphoric acid soluble in acetic acid, 0.021 gm., and lime, 7.2 gm. It was placed in large earthenware pots, and the drainage water which passed through was collected and examined for nitrates. The results were as follows:

Nitric nitrogen per cubic meter of drainage water.

	No. 1.	No. [illegible]
	Grams.	*Grams.*
Collected March 24	584	539
Collected April 7	664	466

These amounts are excessive. As the result of determinations made in 1870, 1872, and 1873 by Dr. Frankland in the drainage water from vegetation boxes at Rothamsted it was found that the nitrogen content per cubic meter was 21.95 gm.; the average of Warington's analyses of drainage water from the same boxes 6 years later was only 10.6 gm.; and at Grignon the average during 1891–'92 was 39 gm.

It was suspected that this excessive amount of nitrates was due to shipping the soil in sacks previously used for nitrate, but inquiry indicated that this was not the case. It is probable, however, that in shipment the sack of soil came in contact with others containing nitrate, and this suspicion is strengthened by the fact that the excessive nitrification indicated by the first determination was not maintained in subsequent experiments. It is true that high amounts of nitrates were observed during the remainder of the year (1891), but they never reached the amount observed at the beginning. October 11, 1891, there was found 196 gm. of nitric nitrogen per cubic meter of drainage water, and on July 21, 1892, 144 gm.

[1] Continued from p. 353.

In 1892 observations of a similar nature were made on two samples of soil of the Limagne of Auvergne—one from Marmilhat and the other from Palbost. Examinations of the drainage water from pots of these soils gave the following results:

Nitric nitrogen per cubic meter of drainage water.

	Marmilhat.	Palbost.
	Grams.	*Grams.*
July 21, 1892	884	440
September 21, 1892	250	285

The results of the first determinations are very high. For comparison the results obtained on other soils in 1890 and 1891 are added:

Nitric nitrogen per cubic meter of drainage water.

	1890.	1891.
	Grams.	*Grams.*
Wardrecques soil	116	33
Blaringhem soil	108	39

When these results are combined and studied the interesting fact is brought out that nitrification is very active in soils recently put under experiment. This confirms an opinion expressed some time ago by Schlösing in discussing a memoir of Corenwinder published in 1856, which stated that in stirred and pulverized soils the production of carbonic acid was more rapid than in undisturbed soil. This accelerated combustion was attributed to the freer circulation of oxygen in the stirred soil, but Schlösing denied this. He stated that stirring the soil favored the spread of organisms which are the agents of combustion. It is evident, he stated, that in a liquid medium the microscopic organisms are able to move freely from place to place and to act upon every portion of the material, but in the soil they do not possess this unrestricted power of locomotion. They are found only on the surface of the particles of moderately moist soils where the very thin film of moisture is decidedly unfavorable to their movement from place to place, and consequently, when the food at any given point is exhausted the activity of the organisms is checked. If the soil is stirred the organisms are scattered and find new supplies of nourishment, and their activity develops again. Schlösing extended this hypothesis to the explanation of the phenomenon of nitrification, but it was not until many years afterwards that experiments on the pulverization of the soil by the author called attention to the importance of this suggestion.

This effect of pulverization was not clearly observed in soils kept in the laboratory and which had been subjected to various manipulations, such as sampling, grinding, sifting, etc. These operations so thoroughly disseminated the ferments that subsequent pulverization produced little effect. It was quite otherwise, however, with soils which had been left undisturbed in place and afterwards pulverized and stirred.

NITRIFICATION IN AUVERGNE AND GRIGNON SOILS AFTER PULVERIZATION AND AËRATION IN AUTUMN.

In the latter part of November, 1892, 50 kg. lots of Palbost and Marmilhat soils were taken to the station building at Grignon. These soils had been selected for experimental purposes in 1890, and had remained unmanured since that time. At the same time a sample of Grignon soil was collected which had remained unfertilized since 1875, except that in the spring of 1891 it had received an application of manure leachings, the effects of which had almost entirely disappeared. As checks Palbost, Marmilhat, and Grignon soils manured in 1891 and remaining in place were used.

The unfertilized soils were spread out on the paved floor of the station building and stirred at various times during about six weeks. The temperature in the building was generally quite low, although when the temperature outside fell below zero the building was heated. In the latter part of December the soils were placed in pots, where they were allowed to remain for some time, a sample of 500 gm. being retained. Of this sample 100 gm. was saturated with water and kept in a closet of the laboratory. Another 100 gm. was kept without being moistened. One hundred-gram lots of the Palbost, Marmilhat, and Grignon soils which had remained in place without being disturbed were submitted to the same manipulation.

In the early part of January, 1893, the samples of soil which had been treated in the laboratory were leached with water to remove the nitrates, the water being applied in 25 cc. lots, until the whole quantity used amounted to 250 cc. This extract was evaporated and nitrates determined in the residue by the ferrous-chlorid and hydrochloric acid method. The following results were obtained:

Nitric nitrogen formed in stirred and unstirred soils (December 20 to January 7).

	Nitrogen dioxid obtained.	Nitric nitrogen in 100 gm. of soil.
Soils saturated with water.		
Grignon:	*Cc.*	*Grams.*
Unstirred	4.0	0.002
Stirred	70.5	.044
Marmilhat:		
Unstirred	3.5	.002
Stirred	82.0	.051
Palbost:		
Unstirred	3.7	.002
Stirred	114.5	.071
Unmoistened soils.		
Grignon:		
Unstirred	5.0	.002
Stirred	62.0	.039
Marmilhat		
Unstirred	4.2	.002
Stirred	74.5	.043
Palbost:		
Unstirred	4.3	.002
Stirred	90.2	.057

The above table clearly shows that aëration and pulverization of the soil had a marked influence on the production of nitrates. The soils which had been exposed to the air in the station building during six weeks in every case gave very much larger amounts of nitrates than those left in place. Do the preceding figures furnish a fair basis for determining the nitric nitrogen which a hectare of soil would furnish if it were submitted to a pulverization as complete as that to which these samples were subjected?

It is usually assumed that a hectare of soil to a depth of 35 cubic meters weighs 4,000 tons.[1] This is calculated on the assumption that the 3,500 cubic meters of a hectare of soil to a depth of 35 cubic meters has a density ranging between 1.1 and 1.2. We must not suppose, however, that the pulverization of a soil in place extends to a depth of 35 cubic meters, but we may safely assume that the stirring of the soil extends at least to one-fourth this depth; that is, the stirred layer of a hectare weighs 1,000 tons. If we multiply the figures obtained above on 100 gm. by 10,000,000 we have the following figures per hectare of 1,000 tons:

Nitric nitrogen per hectare of 1,000 tons.

	Kilograms.		Kilograms.
Lot 1, moistened.		*Lot 2, unmoistened.*	
Grignon:		Grignon:	
Unstirred	20	Unstirred	20
Stirred	440	Stirred	390
Marmilhat:		Marmilhat:	
Unstirred	20	Unstirred	20
Stirred	510	Stirred	460
Palbost:		Palbost:	
Unstirred	20	Unstirred	20
Stirred	710	Stirred	570

For the purpose of collecting the drainage waters the soils which were carried to the laboratory for experiment were placed in pots similar to those in which the undisturbed soil remained. Some of these pots furnished drainage water on January 25 and March 8 which, on analysis, gave the following results:

Composition of the drainage water of stirred and unstirred soils.

Soil.	Date of collecting drainage water.	Amount of water obtained.	Nitric nitrogen found.	Nitric nitrogen per cubic meter of drainage water.	Nitric nitrogen per hectare of 1,000 tons.
		Cc.	*Grams.*	*Grams.*	*Grams*
Grignon:					
Unstirred	Jan. 25	4,390	0.036	8.4	540
Stirred	Jan. 25				
Unstirred	Mar. 8	6,400	.160	25.0	2,400
Stirred	Mar. 8	3,470	8.258	2,380.0	128,870
Marmilhat:					
Unstirred	Jan. 25				
Stirred	Jan. 25	2,370	6.870	1,390.0	49,350
Unstirred	Mar. 8	6,910	.186	27.0	2,640
Stirred	Mar. 8	5,540	6.890	1,240.0	103,050
Palbost:					
Unstirred	Jan. 25	4,640	.025	5.5	375
Stirred	Jan. 25	1,670	7.000	1,420.0	105,000
Unstirred	Mar. 8	6,840	.192	28.0	2,880
Stirred	Mar. 8	3,950	2.256	570.0	33,840

[1] The metric ton containing 2,204.6 lbs.

Although all the soils did not furnish drainage water January 25 and March 8, an examination of the table is very instructive wherever a comparison between the results on stirred and unstirred soil is possible. There is a wide variation between the nitric nitrogen furnished in the differently treated soils. The amounts per cubic meter obtained for the stirred soil are often excessive. For instance, the Grignon soil yielded on March 8 the exceptionally high amount of 2,380 gm.

On submitting the drainage water to a complete analysis, to determine the bases with which nitric acid was combined, it was found that a large part of this acid was in combination with lime, a smaller amount with magnesia, and a still smaller amount with potash. On calculating the amounts of nitric acid required by these bases it was found that a slight excess of nitric acid was present. The amount of nitric acid found was 5.85 gm.; the amount required by the above bases was 5.35 gm. It is very probable that the 0.5 gm. in excess was combined with soda or possibly oxid of iron.

The above results lead to the important and highly interesting conclusion that nitrification is extremely active in different kinds of soils, and that it is capable of furnishing quantities of assimilable nitrogen largely in excess of that required by the most exacting crops. In order to obtain this result is it simply necessary to furnish a humid soil, the proper temperature, and thorough pulverization? Further experiments are necessary to answer this question.

NITRIFICATION IN SAMPLES OF SOIL COLLECTED DURING WINTER AND SPRING.

Samples of frozen soils were collected in January, 1893, at the Museum of Paris and at Grignon. They were exposed to a moderate temperature until they crumbled, and were then pulverized and sifted. Although one series of samples was exposed to the temperature of the laboratory from January 20 until February 16, and the second series from February 14 to May 9, the quantities of nitrates formed remained very small in every case.

A third series of samples was collected in March, when the temperature was beginning to rise. The soils were pulverized with care, sifted, and one lot of samples of each spread out in a dish kept in a closet at the temperature of the laboratory, while the second lot was placed in an oven kept at a uniform temperature of 30° C. Water was added whenever the samples commenced to dry out. When the samples were pulverized a certain portion of each was extracted with water, and these extracts were submitted to analysis, with the following results:

Nitrification in different soils collected in the spring.

Soil.	Temperature.	Nitric nitrogen found in 100 gm. of soil.			Nitric nitrogen per hectare of 1,000 tons.		
		Mg.	*Mg.*	*Mg.*	*Kg.*	*Kg.*	*Kg.*
Grignon	30° C	7.8	7.8	9.7	78	78	97
	Ordinary	5.4	6.6	7.6	54	66	76
Marmilhat (Puy de Dôme)	30° C	14.0	17.5	20.0	140	175	200
	Ordinary	10.9	13.7	15.7	109	137	157
Palbost (Puy de Dôme)	30° C	6.9	23.7	24.0	69	237	240
	Ordinary	4.0	7.5	10.0	40	75	100
Seine-et-Marne	30° C	4.7	7.1	8.7	47	71	87
	Ordinary	3.1	4.4	7.0	31	44	70
Blaringhem (Nord)	30° C	5.5	6.3	8.0	55	63	80
	Ordinary	4.7	5.3	7.3	47	53	73
Wardrecques (Pas-de-Calais)	30° C	6.7	7.5	8.4	67	75	84
	Ordinary	4.0	4.9	6.6	40	49	66

In certain of the soils nitrification went on actively from the beginning. On March 27 Marmilhat soil gave 10.9 mg. at the ordinary temperature and 14 mg. at a temperature of 30° C., while samples collected in the month of January gave only 6.6 mg. after a month had elapsed. In the Marmilhat soil the nitrates increased during the following month, but less rapidly than in the case of the Palbost soil, which furnished moderate quantities on March 27, but increased the amount very rapidly, until on April 10 it furnished 23.7 mg. and on April 24, 24 mg., the highest figures in the series.

The soils collected in the month of March nitrified, therefore, much more actively than those collected in January, but they furnished less nitrates than those collected in autumn. The sample of Palbost soil, which gave, after pulverization in October, in one case 57 mg. of nitric nitrogen and in another 71 mg., furnished in the above experiments a maximum of only 24 mg., although it was kept under conditions of temperature, etc., much more favorable than those which surrounded the samples spread out in the station building the preceding autumn.

It must not be assumed, however, that soils collected in the spring are always in a condition less favorable to nitrification than those collected in other seasons, since a soil from Seine-et-Marne collected at the end of winter furnished in the drainage water of March and the beginning of April 66 kg. of nitric nitrogen per hectare of 1,000 tons in one case and 80 kg. in another, although these figures were calculated on the nitrogen content of the drainage water, which of course less completely removes the nitrates from the soil than the leaching to which small samples of soils are subjected in the laboratory.

Nevertheless it is true in general that the drainage water of spring removes less nitric nitrogen from the soil than that of summer and autumn. This will be clearly seen on examination of the results obtained by analysis of the drainage water of unfertilized and unpulverized Grignon soils shown in the following table:

Average amounts of nitric nitrogen in the drainage water, per hectare, during the years 1890, 1891, and 1892.

	Kilograms.
Spring	17.8
Summer	26.4
Autumn	40.6
Winter	11.8
Whole year	96.6

We thus see that it often happens that samples collected from soils in place and afterwards repeatedly handled furnish very large amounts of nitrates. This is shown in the analyses of the drainage waters of the soils of Seine-et-Marne and of Limagne. We see further that soils collected at the end of autumn and exposed to the air in thin layers for six weeks show an extremely active nitrification, but that when this aëration and pulverization is repeated on hard frozen soils collected in winter the production of nitrates is very slow. Finally it appears that notable amounts of nitrates are formed in samples collected during the month of March, although nitrification is not as active as in the samples collected in autumn. In spite of certain irregularities in detail we may draw the general conclusion that pulverization and aëration of the soil usually result in the formation of considerable quantities of nitrates.

NITRIFICATION IN SOILS STIRRED AT THE SURFACE AND IN THOSE LEFT UNDISTURBED.

The preceding experiments were made in the laboratory. The soils were exposed to the air, stirred and pulverized in a most thorough manner. In order to determine the action under conditions which more nearly approach those of ordinary culture, observations were made during the year 1893 on nitrification in soils in experiment pots, some of which were cultivated while others were left undisturbed.

The year 1893 was particularly unfavorable to this kind of observations in France on account of the exceptionally severe drought of the spring in the vicinity of Paris, and especially at Grignon. It rained, however, during July, and drainage water was also collected in abundance during the autumn. The table below shows the results obtained on two Grignon soils, one of which was cultivated at the surface on February 17, and frequently thereafter during the year, while the other remained undisturbed.

Drainage water and nitric nitrogen from a soil stirred at the surface and from an undisturbed soil.

Date at which drainage water was collected.	Stirred soil.			Unstirred soil.		
	Amount of drainage water obtained.	Nitric nitrogen per liter.	Nitric nitrogen found.	Amount of drainage water obtained.	Nitric nitrogen per liter.	Nitric nitrogen found.
	Liters.	*Grams.*	*Grams.*	*Liters.*	*Grams.*	*Grams.*
March 8	5.700	0.022	0.125	6.000	0.020	0.120
July 27	7.950	.084	.164	2.500	.067	.167
October 9	5.000	.164	.820	5.150	.073	.376
October 24	3.180	.041	.130	3.000	.030	.090
November 26	6.000	.030	.180	7.200	.028	.201
Entire period	21.830	.065	1.419	23.850	.040	.954

The effect of cultivation was appreciable only on October 9. During the first part of the period the results obtained on the two soils are very similar. A number of other soils were used in this comparison and the sums of the nitrogen found on March 8 and November 26, calculated to 50 kg. of soil, are given in the table below.

Nitric nitrogen found in cultivated and uncultivated soils.

	Nitric nitrogen.
	Grams.
Wardrecques soil:	
Cultivated	1.181
Uncultivated	.946
Grignon soil (poor):	
Cultivated	1.209
Uncultivated	1.055
Grignon soil (poor):	
Cultivated	1.193
Uncultivated	.650

All of the results point in the same direction, despite the fact that the season was so unfavorable that nitrification was almost completely checked.

The soils of Auvergne in the region of Palbost and Marmilhat were also experimented with. They are easily affected by drought and when they are not cultivated nitrification goes on very slowly in them. The results obtained on these soils were as follows:

Nitric nitrogen found in cultivated and uncultivated soils.

	Nitric nitrogen.
	Grams.
Marmilhat soil:	
Cultivated	1.356
Uncultivated	.483
Palbost soil:	
Cultivated	1.213
Uncultivated	.386

It is evident, therefore, from the above results that cultivation and aëration of the soil favor to a marked degree the activity of nitric ferments. But before drawing any conclusions let us examine the results obtained by experiments in this line on vegetation boxes.

RESULTS OBTAINED ON VEGETATION BOXES AT GRIGNON DURING THE YEARS 1892 AND 1893.

Vegetation boxes were constructed on the experimental fields of Grignon during the autumn of 1891. Their capacity is 4 cubic meters, the surface being 2 meters square and the depth 1 meter. The walls are made of an impervious cement in which is embedded a wire netting to give it strength. The floor dips in the middle so as to form a gutter and slopes toward the northern wall of the box. In the lower end of the gutter a lead pipe is cemented through which the drainage water flows into a large carboy placed in a recess under the box.

In constructing the boxes it was necessary to remove the soil, which was thrown into heaps, the subsoil and the surface soil being kept separate. The boxes were completed in November, 1891, and drainage waters began to be regularly collected in March, 1892. Four boxes were kept free from vegetation in 1892 and 1893 in order to study nitrification. The results obtained from March, 1892, to March, 1894, are given in the following table:

Nitrification in vegetation boxes.

No. of box.		Manuring.	Cultivation.	Drainage water obtained.	Nitrogen per liter.	Total nitrogen removed.	Nitrogen per hectare.
				Liters.	*Grams.*	*Grams.*	*Kilograms.*
1	1892	Nothing	Nothing	661.0	0.135	88.628	221.570
	1893	do	do	401.0	.079	31.679	79.198
12	1892	12 kg. of manure	do	717.5	.107	77.269	180.672
	1893	Nothing	Forking	439.0	.101	44.339	110.840
13	1892	12 kg. of manure, 100 gm. nitrate of soda.	Nothing	734.3	.148	76.981	192.450
	1893	Nothing	do	434.0	.083	36.022	90.055
14	1892	250 gm. nitrate of soda.	do	696.5	.142	99.279	248.197
	1893	Nothing	Thorough cultivation and forking.	440.5	.116	51.098	127.745

In the preceding table the term "forking" indicates a superficial cultivation with a fork with bent tines which secured a thorough stirring of only the surface soil. In case of No. 14 the soil had been thoroughly spaded in 1893.

It will at once be observed that the drainage waters were very much more abundant in 1892 than in 1893, but what is more striking is the enormous difference in the amount of nitric nitrogen formed during the 2 years. In the case of box No. 1 the quantity of nitrogen found in 1892 was almost three times that obtained in 1893. For box No. 13 about double the amount was found, while for boxes Nos. 12 and 14, although the difference is less, it is still considerable. Among the various causes of these differences it appears that the very different treatments to which the soils were submitted during the 2 years were especially important. As stated above, the vegetation boxes were constructed in the autumn of 1891; the soil which they contained was removed, thrown into heaps, and remained exposed to the air during several months. When it was returned to the boxes in autumn,

therefore, it was as thoroughly pulverized as the soil sent from Seine-et-Marne, from the Limagne of Auvergne, or those which had been exposed to the air during 6 weeks in the station building in the autumn of 1892. It is to this thorough aëration and mixing of the soil that the author attributes the activity of nitrification in 1892.

This activity was such that it almost completely masked the influence of the manure, for we observe that No. 1, which had not been manured, furnished more nitric nitrogen than Nos. 12 and 13, which had been manured. The amount obtained from No. 14, it is true, exceeded that from No. 1 during the year 1892, but it should be borne in mind that No. 14 received 37 gm. of nitric nitrogen, while No. 1 had received no manure. The averages of the amounts of nitrogen removed in the drainage water per hectare during the 2 years are as follows: 1892, 210.722 kg.; 1893, 101.959 kg. Nitrification therefore decreased one-half during 1893.

Without doubt the meteorological conditions of 1893 were very unfavorable, and the persistent drought of the spring may possibly have contributed to produce the slow nitrification during this year. However, it did not mask the influence of cultivation during this year. Box No. 1, which received no cultivation, furnished 31.679 gm. of nitric nitrogen; No. 13, which received no cultivation and remained undisturbed, yielded only 36.22 gm., while it was increased to 44.339 gm. on No. 12 by simply stirring with a fork, and to 51.098 on No. 14, which received a spading in addition to the forking. This superficial cultivation, however, is not equivalent to the aëration to which the soils were subjected during the construction of the boxes and to the very complete mixing which they underwent before being placed in the boxes in the autumn of 1891, as is shown by the superiority of the nitrification in 1892 over that of 1893.

RÉSUMÉ AND CONCLUSIONS.

The experiments reported in the preceding article clearly demonstrate that those agriculturists who have long attributed to cultivation of the soil a decisive influence on nitrification have held a correct view of the subject. This influence is, in fact, much greater than might be supposed. A soil properly stirred and aërated is capable of producing much greater amounts of nitrates than are required to sustain the most abundant crops.

The enormous reserves of nitrogenous matter which arable soils contain are therefore not destined to remain indefinitely inactive. We will not always be reduced to the necessity of paying cash down for assimilable nitrogen and of importing each year large amounts of nitrogen compounds to make up the deficiency in the production of assimilable nitrogen in the soil. Nitrogen compounds are found in profusion in the soil, and the experiments which we have reviewed show that the transformation of inert organic matter in nitrates may be greatly accelerated by cultivation of the soil.

The most important part of the cultivation of the soil is done in October or November. The soil broken up by the plow and rendered absorbent stores up the rain water of winter, which would flow off the surface of a soil hardened by dryness or compacted by rain. The first cultivation is very well performed by the plow, but this implement does not do more than to turn over the sod without breaking it, and arrange it in parallel strips. There is no pulverization, and this is an advantage if the soil is to remain uncovered during the winter, since pulverization promotes an active nitrification, which is very undesirable under these conditions, the nitrates formed in a soil without vegetation being irrevocably lost.

When the time of seeding approaches, however, as thorough pulverization as possible is desirable. The harrows and cultivators which are commonly used do not answer the purpose, since they stir the soil very imperfectly. Our efforts should be directed toward improving these implements in this respect. The advantage of perfect cultivation in the soil is seen among the French peasants. They cultivate their fields again and again in different ways, and without knowing it promote a very active nitrification. Cultivators of sugar beets know that the weight of roots harvested increases with the number of cultivations to which the crop is subjected.

From the earliest times cultivation of the soil has been considered as labor *par excellence*. The man who performs it is known as "the laborer." Slowly and laboriously through the ages he has perfected his implements. From the piece of wood hardened in the fire and drawn by an ass he has passed to the plow drawn by oxen or the more powerful implement driven by steam. But further efforts are still necessary in order to utilize the immense reserves of the soil. The plow is the emblem of agriculture only until we are able to find a better. The soil is a niggardly mother who distrusts her wasteful children and refuses at first to give up her treasure, but yields finally to the supreme force of the world—work.

RECENT WORK IN AGRICULTURAL SCIENCE.

CHEMISTRY.

On the Gunning method for total nitrogen in fertilizers, W. E. GARRIGUES (*Jour. Amer. Chem. Soc., 16 (1894), No. 12, pp. 795–799*).—By following the directions of the official methods[1] the Gunning method invariably gave lower results than the Kjeldahl method.

> "Successful results were finally obtained by using the same reagents, both kind and quantity [as recommended in the official methods], but varying the mode and order of their addition. . . . The chief fault is in the addition of potassium sulphate at such an early stage in the process, the large quantity of dry powder forming an effectual blanket over the sample, that for some time resists the permeation of the viscid acid solution.
>
> "The best procedure was found to be: Adding the salicylic acid mixture directly to the sample in the flask, which is then shaken until the liquid has thoroughly wetted the dry organic matter; allow to stand about 15 minutes, and add the thiosulphate with constant shaking. This should be done in 4 or 5 portions, following with a fresh crystal only when the one previously added has completely dissolved. The potassium sulphate is then put in and the whole again well agitated. Digest as usual."

Even with this modification there appeared to be a tendency to low results on mixtures containing a considerable proportion of nitrogen in the form of nitrate; and with pure nitrate of soda both this method and the modified Kjeldahl method gave results considerably too low.

The determination of phosphoric acid by the molybdate-magnesia method, B. W. KILGORE (*Jour. Amer. Chem. Soc., 16 (1894), No. 12, pp. 793–795*).—The results of 34 determinations by 26 chemists of the Association of Official Agricultural Chemists of phosphoric acid in a sample of disodium hydrogen phosphate containing theoretically 19.826 of phosphoric acid are discussed. The highest result reported was 20.67 per cent; the lowest, 19.74; the average, 20.09. Investigations are reported which lead to the conclusion that this tendency to high results is due to excess of magnesium in the ammonium magnesia phosphate, as Neubauer has pointed out. This may be obviated by dissolving in hydrochloric acid and reprecipitating or by precipitating in the presence of citric acid.

Investigations on the determination of potash by the Lindo-Gladding method, J. VAN DEN BERGHE (*Lab. Agr. Prov. Roulers,*

[1] U. S. Dept. Agr., Div. Chem. Bul. 38, pp. 172, 174.

West Flanders, Rpt. 1893, pp. 23–25).—In view of the difference of opinion as to the accuracy of this method the author undertook comparisons of it with the ordinary method on samples of chemical fertilizers, irrigation water, wood ashes, and oil cakes containing percentages of potash ranging from 0.59 to 21.85, with the following results:

Percentages of potash by the ordinary and Lindo-Gladding methods.

	Ordinary method.	Lindo-Gladding method.	Difference.
	Per cent.	*Per cent.*	*Per cent.*
Chemicals	4.86	4.88	+0.02
Do	21.85	21.80	—.05
Do	5.25	5.22	—.03
Do	.59	.59	....
Irrigation water (results calculated to grams per cubic meter)	13.12	13.03	—.09
Colza cake (Guzerath)	1.35	1.34	—.01
Cocoa oil cake	1.73	1.83	+.10
Wood ashes	9.02	8.97	—.05

Analyses of butter, F. SEILER and R. HEUSS (*Schweiz. Wochenschr. Chem. Pharm., 32 (1894), pp. 285–291; abs. in Chem. Ztg., 18 (1894), No. 70, Repert., p. 213*).—In a large number of samples of butter of undoubted purity the volatile fatty acids by the Reichert-Meissl method were found to vary from 26.18 to 32.78, never falling below 26; where the distillation was with steam the acids were never below 30, confirming what has long been claimed—that by ordinary distillation a part of the acids remained in the residue in the flask. The parallel results by this method of distilling agreed closely. In the samples mentioned the water content ranged from 11.24 to 15.64 per cent, the fat from 82.93 to 88.25, and the ash from 0.061 to 0.167 per cent.

On the determination of lime in soil, G. BASILE and E. DE CILLIS (*Staz. Sper. Agr. Ital., 27 (1894), No. 2, pp. 115–157*).

Triammonium phosphate and the qualitative determination of magnesium, P. SCHOTTLÄNDER (*Ztschr. anorgan. Chem., 7 (1894), No. 5, pp. 343, 344*).

On the chemical composition of the efflorescence on brick walls and on the nitrates which it contains, O. HELM (*Schriften Naturf. Ges. Danzig, 8 (1894), No. 3 and 4, pp. 168–179*).—Numerous analyses are reported showing this substance to consist essentially of variable amounts of calcium carbonate; sulphate of soda, magnesium, or lime; salt; nitrates of lime or alkalies; and insoluble matter. Investigations are reported which indicate that the nitrates are formed from the ammonia of the air by microörganisms, as is the case in soils.

On ash-free albumen, K. BÜLOW (*Pflüger's Arch. Physiol., 58, No. 5 and 6, pp. 207–221*).—Details of its preparation, properties, etc.

The chemistry of carbohydrates and their importance to physiology, E. FISCHER (*Die Chemie der Kohlenhydrate und ihre Bedeutung für die Physiologie. Berlin: A. Hirschwald, 1894*).—A lecture.

On melitriose and its quantitative determination, A. BAU (*Chem. Ztg., 18 (1894), No. 92, pp. 1794–1799*).

On the determination of mannite in wines, J. A. MULLER (*Bul. Soc. Chim. Paris, 11–12 (1894), No. 22, pp. 1073–1080*).

Studies on the oxidation of alcohol by Fehling's solution, F. GAND (*Compt. Rend., 119 (1894), No. 20, pp. 862, 863*).

A new gravimetric method for determining glucose, F. GAND (*Compt. Rend., 119 (1894), No. 10, p. 478; abs. in Chem. Ztg., 18 (1894), No. 78, Repert., p. 234*).

On the determination of glucose by akaline copper solutions, F. GAND (*Compt. Rend., 119 (1894), No. 16, pp. 650–652*).

Influence of the volume of the precipitates thrown down by lead acetate as well as by soda and Glauber's salts on the results of the sugar titrations before and after inversion, A. BORNTRÄGER (*Ztschr. angew. Chem., 1894, No. 19, pp. 583–591*).

Concerning the modification of the reducing power of invert sugar solutions by evaporating or allowing to stand with lead acetate, A. BORNTRÄGER (*Ztschr. angew. Chem., 1894, No. 19, pp. 579-582*).

Methods for the examination of food stuffs, etc., G. RUPP (*Die Untersuchung von Nahrungsmitteln, Genussmitteln, und Gebrauchsgegenstanden. Heidelberg: Carl Winter's Universitäts Buchhandlung, fig. 115*).

Contributions to the analysis of lard, G. HALPHEN (*Jour. Pharm. et Chim., 30 (1894), pp. 241–247; abs. in Analyst, 19 (1894), Dec., p. 282*).

A digester with regulator and automatic feeder for determinations requiring a low temperature, J. VAN DEN BERGHE (*Rev. Agron. Louvain, 1894, No. 3, pp. 214–219, pl. 1*).

Improvements in analytical balances, L. S. DE KONINCK (*Chem. Ztg., 18 (1894), No. 95, p. 1867*).

An apparatus for furnishing both hot and cold sterilized water (*Chem. Ztg., 18 (1894), No. 95, p. 1869, fig. 1*).

Constant level and temperature water bath, J. VAN DEN BERGHE and M. COSTELEIN (*Lab. Agr. Prov. Roulers, West Flanders, Rpt. 1893, pp. 19–22, figs. 4*).

Hydrogen sulphid generator, H. G. SCHAUCHE (*Jour. Amer. Chem. Soc., 16 (1894), No. 12, p. 868, fig. 1*).—A form of apparatus is described and illustrated which is claimed to "furnish an absolutely uniform supply of gas."

Modification of Knorr's extraction apparatus, O. CARR (*Jour. Amer. Chem. Soc., 16 (1894), No. 12, pp. 868, 869, fig. 1*).—A cork fitted over the neck of the receiving flask is substituted for the mercury seal of Knorr's apparatus (see U. S. Dept. Agr., Div. Chem. Bul. 28, p. 97).

Laboratory devices, E. WALLER (*Jour. Amer. Chem. Soc., 16 (1894), No. 12, pp. 869–873, figs. 2*).—The burette filling device, condenser, and revolving Nessler tube rack and Nessler comparator used in the laboratory of C. H. Shultz, of New York, are described.

New laboratory apparatus (*Chem. Ztg., 18 (1894), No. 95, p. 1868, figs. 2*).—Illustrated description of a laboratory vacuum, the lower half of which is of porcelain, and a small hot-air motor for running stirring apparatus, etc.

The new chemical institute of the University of Halle, R. SCHENCK (*Chem. Ztg., 18 (1894), No. 94, pp. 1848–1853*).—Description and plans of the building, desks, cases, etc., and description of the heating, ventilation, plumbing, gas fitting, electrical apparatus, and other details of equipment.

BOTANY.

Concerning the number of species of tubercle bacteria of Leguminosæ, F. NOBBE, L. HILTNER, and E. SCHMID (*Landw. Vers. Stat., 45 (1894), No. 1 and 2, pp. 1–27, fig. 1; abs. in Chem. Centbl., 1894, II, No. 16, pp. 705–707*).—The authors have sought to determine whether there is more than a single species of tubercle bacteria among the *Leguminosæ*. Previous experiments[1] conducted by them with pure cultures of bac-

[1] Landw. Vers. Stat., 39 (1891), pp. 327–359; E. S. R., 3, p. 336.

teria from the tubercles of *Robinia* and *Pisum* showed different effects on the plants, but from this difference the authors think there was nothing to show that the bacteria were specifically distinct. Recently several series of experiments were conducted in pure quartz sand with inoculations from pure cultures of bacteria from various legumes. In one series peas and the common locust were inoculated with cultures from the tubercles of *Pisum sativum*, *Vicia sepium*, *Medicago sativa*, *Robinia pseudacacia*, and *Caragana arborescens*. Tubercles were formed on the peas from all the inoculations, while on the locust only those receiving the cultures from the tubercles of *Robinia* and *Caragana* produced any. In another series *Lathyrus latifolius* was inoculated from pure cultures of *Pisum*, *Vicia*, and *Robinia* bacteria. Only the first two produced tubercles. In the third series plants of *Robinia pseudacacia*, *Acacia lophantha*, *Vicia villosa*, and *Pisum sativum* were inoculated from cultures of 2-year-old tubercles of *Robinia*, 2 year-old tubercles of *Caragana*, tubercles of *Vicia* and *Pisum*. The tabulated results observed are shown below. Before the experiments were completed a fungus destroyed some of the peas and they were necessarily omitted from the last two tables.

Transpiration from inoculation to harvest.

	Inoculated with pure cultures from—			
	Robinia.	*Acacia.*	*Vicia.*	*Pisum.*
	Cc.	*Cc.*	*Cc.*	*Cc.*
Robinia pseudacacia	3, 570	1, 136	1, 425	1, 396
Acacia lophantha	1, 538	3, 805	1, 205	1, 511
Vicia villosa	934	1, 097	4, 978	1, 277
Pisum sativum	1, 380	1, 034	1, 265	1, 849

Average height of plants at harvest.

	Inoculated with pure cultures from—			
	Robinia.	*Acacia.*	*Vicia.*	*Pisum.*
	Mm.	*Mm.*	*Mm.*	*Mm.*
Robinia	131	50	50	50
Acacia	80	295	62	75
Vicia	350	400	1, 126	450

Chemical analysis of plants.

	Inoculated with pure cultures from—			
	Robinia.	*Acacia.*	*Vicia.*	*Pisum.*
Robinia dry substance .... grams	7. 402	1. 158	0. 858	1. 479
Robinia nitrogen .... milligrams	232. 100	16. 600	13. 500	21. 100
Acacia dry substance .... grams	1. 953	6. 943	1. 248	1. 817
Acacia nitrogen .... milligrams	17. 000	109. 800	16. 200	19. 700
Vicia dry substance .... grams	. 783	. 866	9. 133	1. 033
Vicia nitrogen .... milligrams	12. 900	14. 700	264. 000	22. 600

From the above tables it will be seen that in all but one case each plant was most favorably affected when it was inoculated with bacteria from the tubercles from its own species.

Another series of experiments was conducted by inoculating a number of species of legumes with bacteria from the tubercles of *Pisum* and *Robinia*. The species so inoculated were: *Ornithopus sativus*, *Sarthamnus scoparius*, *Cytisus laburnum*, *Ulex europæus*, *Lupinus luteus*, *L. augustifolius*, *Anthyllis vulneraria*, *Trifolium pratense*, *T. incarnatum*, *Melilotus alba*, *Medicago sativa*, *M. lupulina*, *Lotus corniculatus*, *Robinia pseudacacia*, *Colutea arborescens*, *Vicia faba*, *V. villosa*, *V. hirsuta*, *Lens esculenta*, *Phaseolus vulgaris*; and *P. multiflorus*. The species of *Vicia*, *Lens*, and *Phaseolus* developed a great many normal tubercles when inoculated with *Pisum* bacteria, while on *Trifolium incarnatum* and *Robinia pseudacacia* only a few scattered tubercles were formed when similarly treated. The other species were wholly unaffected. Of those inoculated with *Robinia* bacteria only *Robinia* gave a good development of tubercles. The species of *Phaseolus* bore numerous but small tubercles and *Trifolium pratense* had a few scattered ones. All others showed an entire absence of tubercles.

After investigating the organisms present in all the cases coming under the authors' observation they conclude that the bacteria present in all the tubercles, even those of the *Mimoseæ* are of the species *Bacillus radicicola* of Beyerinck; that they are more or less modified by the host on which the tubercles are grown, and that the especially modified forms are more capable of causing tubercles to develop on plants of the same or nearly allied genera than on others. They think the differences between the forms not sufficiently differentiated to be entitled to specific rank.

In practical application of inoculation by means of soil the above facts should be borne in mind and selections made from fields where crops have been grown similar to the one desired.

Cell membrane of fungi, E. GILSON (*La Revue "La Cellule," 11, pp. 7–15; abs. in Chem. Centbl., 1894, II, No. 21, p. 874*).

On the ascent of sap, H. H. DIXON and J. JOLY (*Ann. Bot., 18 (1894), No. 32, pp. 468–470*).

Secretions and their formation, A. TSCHIRCH (*Bot. Centbl., 60 (1894), No. 10, pp. 289–293*).

Protoplasm and nucleus, J. PÉREZ (*Mem. Soc. Sci. Phys. et Nat. Bordeaux, ser. 4, 4 (1894), No. 2, pp. 277–305*).

The function of awns on an ear of barley (*Abs. in Fühling's landw. Ztg., 43 (1894), No. 23, p. 745*).—The writer cites an experiment in which cutting off the awns or beards decreased the amount of water transpired.

The nettle hairs of parsnips, J. BLANCHARD (*Rev. Hort., 66 (1894), No. 18, pp. 427, 428*).—A discussion of the physiological action of this character, which is found on *Pastinaca sativa*, *P. opaca*, and *P. urens*, but more on the last. The hairs are irritating to animals as well as to man, and produce an annoying and painful skin eruption. It is recommended that if parsnip tops be fed to stock care should be taken that they are still fresh and unwithered.

On the traumatropic curvature of roots, V. M. SPAULDING (*Ann. Bot., 8 (1894), No. 32, pp. 423–451, pl. 1*).—Phenomena observed to follow the infliction of wounds upon the top of growing roots. Experiments with *Lupinus albus*, *Vicia faba*, *Pisum sativum*, *Ricinus communis*, *Zea mays*, aërial roots of *Vitis gongylodes*, and *Anthurium* spp.

On the assimilation of nitrates by plants, E. DEMOUSSY (*Compt. Rend., 119 (1894), No. 20, pp. 868–871*).

Root tubercle bacteria and their interchangeability toward different legumes (*Abs. in Staz. Sper. Agr. Ital., 27 (1894), No. 2, p. 224*).

The effect of quicklime on root tubercles, SALFELD (*Deut. landw. Presse, 21 (1894), No. 100, p. 962*).—A short article in which the author gives additional reasons for his attributing to quicklime in his experiment elsewhere reported (p. 533) an injurious action on root tubercles.

The action of lime on root tubercles, VREIZĖ (*Deut. landw. Presse, 21 (1894), No. 96, pp. 895, 896*).—A short article questioning the correctness of Salfeld's hypothesis that quicklime destroys root tubercles.

The respiration of leaves, L. MAQUENNE (*Ann. Agron., 20 (1894), No. 11, pp. 528–533*).—An abstract of this article was printed in E. S. R., 6, p. 193.

Influence of colored light on production and transpiration of plants, E. WOLLNY (*Forsch. Geb. agr. Phys., 17 (1894), No. 3 and 4, pp. 317–333; abs. in Bot. Centbl., 60 (1894), No. 7, pp. 216–218*).

Hybridization without crossing, or false hybridization, A. MILLARDET (*Mem. Soc. Sci. Phys. et Nat. Bordeaux, ser. 4, 4 (1894), No. 2, pp. 347–372*).

Text-book on botany, E. STRASBURGER, F. NOLL, H. SCHENCK, and F. W. SCHIMPER (*Lehrbuch der Botanick für Hochschulen. Jena: Gustav Fischer, pp. 558, figs. 577*).

FERMENTATION—BACTERIOLOGY.

Action of certain bacteria under high pressure, H. ROGER (*Compt. Rend., 119 (1894), No. 23, pp. 963–965*).

Researches on the antiseptic power of formic aldehyde, H. POTTEVI (*Ann. Inst. Pasteur, 8 (1894), No. 11, pp. 796–810*).

The action of sulphate of copper, phenic acid, and salts of iron, lead, and mercury on yeast, H. H. MANN (*Ann. Inst. Pasteur, 8 (1894), No. 11, pp. 785–795*).

Action of light on bacteria and fungi, H. M. WARD (*Chem. News, 70 (1894), No. 1824, pp. 228–230; No. 1825, pp. 241–244; No. 1826, pp. 251, 252; and No. 1827, pp. 263, 264*).

METEOROLOGY.

Some interrelations of climatology and horticulture, L. H. BAILEY (*U. S. Dept. Agr., Weather Bureau Bul. 11, pt. 2, Rpt. Internat. Meteorolog. Congress, 1893, pt. 2, pp. 431–435*).—Local climate exerts a most powerful influence upon the plants which one attemps to grow; it becomes the controlling factor in every scheme of rural industry. The climatal limit of any crop, in all directions, is an exceedingly irregular one, presenting a series of sharp curves; that is, the local variations of climate determine the distribution of cultivated plants.

The horticulturist is vitally interested in the climate of his particular neighborhood; and it is the study of this local climate in its relation to plant life which must bring him the greatest good from climatological science.

Meteorological records should be expressed in terms of plant life rather than in terms of degrees of temperature or other numerical standards. For instance, the peach growers of a certain geographical area might make observations for a number of years upon the relative

synchronisms of late frosts and blooming time. The tabulation of these observations would enable us to construct two series of curves, which would indicate at a glance the comparative safety of any station for the cultivation of the given crop. The observations at the various stations could be graphically represented by means of two curves, one indicating the date of last killing frost for each station, the other the date of the opening of the peach flowers. Wherever the frost line lies beyond the bloom line (the frost occurring later than the blooming) peach growing is impossible. When the reverse takes place (the frost occurring before the blooming time) peach growing is possible and the industry is safe in proportion as the two lines diverge. These tabulations would be valuable in proportion as they include a minute record of every farm in the given territory; but even a somewhat superficial series of observations would possess great value if accurately made, as indicating the probable influence of local climate upon the given industry. If the lines tend to converge, or if the frost line crosses beyond the bloom line, there is indication, at least, that safe peach lands are few in those localities. The information which these records ask could be well ascertained from observations upon a few peach trees here and there long before any general experiment of cultivation had been tried.

What has been said of the synchronisms of frosts and blooming period can be repeated with almost equal force for many other attributes of climate in their relations to plant life. The synchronisms of early fall frosts and maturation of certain fruits are subjects of immense importance to the horticulturist. The northern limit of grape culture, for instance, is determined much more by the date of early fall frosts than by winter climates. This is well illustrated by the Catawba, which is our most important native wine grape. It hugs the shores of certain lakes in western New York so closely that the majority of New York grape growers are unfamiliar with its cultivation, and fear that its area can not be greatly extended with safety; yet there are undoubtedly enough isolated Catawba vines in most of the fruit regions of the State to enable observations to be made for a term of years, and which might give rise to a reliable monograph of the climatal limitations of the variety within the State.

Contemporaneous effects of seasonable climates can not be studied upon the wild plants of a region, for these plants have long since overcome the difficulties of the particular climate, or have become acclimatized. Cultivated plants which have been brought in from other climates must, therefore, be chosen as the registers of the meteorological peculiarities of a given region.

There are numerous problems of still more local application which are yet of vital importance to the cultivator and in the solution of which he has the right to expect the aid of the climatologist. The habitual force and frequency of winds during the seasons of maturation of fruits,

the prognostication and methods of averting frosts, the influence of wind breaks and orchards upon local climate, the modification of climate in consequence of the removal of forests and the clearing of land, the frequency of droughts, the humidity of atmosphere as affecting the spread of fungus diseases, and the ability to prognosticate serious incursions of these diseases from a study of their general relations to climate, the liability to hail storms, the nature of the seasonal variations, these, in addition to the subjects already indicated, are some of the living problems which await us.

Every plant is profoundly modified by the climate in which it is placed; and if any species, therefore, is cultivated over a wide range of territory we must expect to find it widely variable between the extremes of distribution. The same variety of apple, for instance, may lose all its distinguishing qualities and marks through a simple transfer to climates not far removed. A study of the statistics of apple exportations during the next ten years will probably show what States or districts produce fruits of sufficient firmness and long-keeping qualities to withstand the journey profitably. And it is not too much to ask of climatology that it shall tell us why the Northern climates develop saccharine elements and high colors, and why the Wisconsin-Minnesota area produces such remarkable waxen and pruinose tints. The influence of climate is nowhere so easily traced, perhaps, as in the business of seed growing. Every seedsman knows that certain climates are not only best adapted to the growth of certain seed crops, but that they exert a profound influence upon the character of the product grown from them.

The study of all these interrelations of climate and plant life falls into three subjects: Phenology, or the study of the periodic phenomena of plants, a subject which loses half its force and value when considered, as it usually is, without reference to the visible attending features of climate; acclimatization, or a consideration of the means by which plants adapt themselves to climates at first injurious; and secondary variation of plants induced by climatal environment.—O. L. FASSIG.

Phenologic, or thermal, constants, E. IHNE (*U. S. Dept. Agr., Weather Bureau Bul. 11, pt. 2, Rpt. Internat. Meteorolog. Congress, 1893, pt. 2, pp. 427–431*).—The problem of thermal constants of vegetation has not made progress since the death of Dr. H. Hoffmann, the indefatigable exponent of this theory, in 1891. Hoffmann began with January 1 as a day of vegetal rest and added together the daily positive maxima of a thermometer fully exposed to the sun, up to the day on which the vegetal phase in question set in, as, for instance, the first blossoming of certain plants. The values obtained by Hoffmann were so constant that he believed he had demonstrated, for Giessen, at least, that there existed between vegetal development and such supply of heat certain legitimate quantitive relations. Although the same vegetal phase may

set in on a date varying from year to year, the date depending primarily on the climate of each year, yet to reach this phase the plant requires an amount of heat that is constant from year to year. A plant may, therefore, be considered as a means for measuring heat, and the beginning of a certain vegetal phase is also a standard for measuring a certain sum total of heat supplied up to that date, and this sum total expresses the measure of heat required by the plant to reach the phase in question.

Different sums were, and must be, obtained with thermometers of different construction, but not so with the same instruments. Most investigators who have occupied themselves with the problem of thermal constants have, in their calculations, made exclusive use of shade temperatures, either the mean or the maximum temperatures; and this is still the case at Russian stations. But all methods of paralleling vegetal development with thermometric values are open to numerous and legitimate objections. Above all, stress must be laid on the fact that plant life, in its period of growth, is governed by the joint effect of the climatic factors, heat, light, and moisture, but that we are hardly able to reciprocally weigh their individual power. Further, that which causes our trees and shrubs to bud and blossom in the spring is not only a consequence of the gradual increase of heat, together with light and sufficient moisture, but these vegetal phenomena are also the effects of an obscure biological property, a certain interior rythm of the ligneous plants, by which they perform annually, with suitable periods of rest, the same functions in regular sequence. This rythm has adjusted itself to the average climate. Connected with this is the fact that the duration of the period of rest also exerts an influence on the development of vegetation, and, therefore, can not arbitrarily be shortened so as always to produce by an artificial increase of temperature (hot houses), in a relatively short time, the same effect as that produced by a lower temperature continued through a longer period.

This reckoning must, without doubt, begin from a natural zero point of vegetation. But where is this point in nature? With deciduous plants we may safely select the day of sowing similarly treated kinds of seeds, but with our ligneous plants it should probably be the beginning of the period of rest or the beginning of vegetal activity. But the beginning of either period is very hard to determine, for phenologic observations have demonstrated that the vegetal activity of buds does not entirely cease even during the winter period of rest. The first day of January, which has been selected in many methods as a day of complete winter rest, is therefore a somewhat arbitrary date, although the error is propably a small one. Drude suggests the date of the winter solstice, or the first day of December. Ziegler (Frankfort-on-the-Main), who otherwise follows Hoffmann's method, reckons from the beginning of a vegetal phase in one year to the beginning of the same phase in the year following.

We must abandon the conception that the summation of heat, which has been ascertained for a certain vegetal phase at any one locality, is a measure of the amount of heat which that phase requires; but it must be considered as a measure of the amount of heat which that locality affords to the phase and to which the latter has accommodated itself. It is, therefore, not a relation of cause and effect, but one of accommodation that exists between sums total of heat and vegetal phases; and it remains now to determine whether of our thermometric measurements these sums furnish the suitable measure in which this accommodation is reflected.

In the further prosecutions of these investigations the following points should be kept in view:

An instrument as nearly perfect as possible should be contrived for the simultaneous measurement of light and heat, and the same style of instrument should be used at all stations of observations.

The starting point of the reckoning must be the same at all stations.

As a fundamental condition the values obtained at any one station must be constant from year to year for the vegetal stages in question, which should always be observed on the same specimens. When this has been demonstrated for several localities the values obtained at the different stations for the same species can be compared one with another. It will most certainly be found that these values are not equal one to another; and it is probable that legitimate relations will be obtained concerning the capacity of different plants to accommodate themselves to the same climate, and the capacity of the same plant to accommodate itself to different climates, i. e., the same relations which Linsser, as early as 1867, made a subject of investigations.

Annual phenologic observations are now made in all European countries, excepting only the Balkan Peninsula, southern Italy, and Spain. The reports are usually published once a year. The time of the first blossoming of the most widely distributed woody plants is noted with particular frequency; next in consideration comes the beginning of foliation, the ripening of fruits, and the time when leaves change color everywhere. The beginning of the blossoming time (first blossoms) is the most readily observed phase.

In order to obtain uniformly comparable results it is necessary that the observations be made under normal conditions, i. e., on average standard specimens, under normal (not extreme) exposure, otherwise there is danger of noting an exceptionally early or exceptionally late specimen. It lies in the nature of the matter that in noting the phases it is not absolutely necessary to observe the same specimens in each year.—O. L. FASSIG.

Bibliography of the meteorology of the fifteenth, sixteenth, and seventeenth centuries, G. HELLMANN (*U. S. Dept. Agr., Weather Bureau Bul. 11, pt. 2, Rpt. Internat. Meteorolog. Congress, 1893, pt. 2, pp. 352–394*).—A list of about 250 books relating to meteorology and ter-

restrial magnetism, all printed prior to 1700, and all in the private library of Dr. Hellmann, of Berlin.—O. L. FASSIG.

Annual weather summary, 1893, J. G. LEE (*Louisiana Stas. Bul. 29, 2d ser., p. 1048*).—A tabulated summary of observations during each month at the North Louisiana Station on temperature, rainfall, etc. The highest temperature, 97°, was recorded on June 26, July 26, August 3, and September 15; the lowest, 18°, on January 16 and 20. The mean temperature for the year was 63.9°; total rainfall, 43.21 in., and the number of rainy days, 77.

Meteorological summary for Utah, 1893, J. DRYDEN (*Utah Sta. Rpt. 1893, pp. 257–271*).—Tables give (1) the daily readings of the maximum and minimum thermometers and the daily range for the year; (2) a daily record of the relative humidity and dew-point for 7 months of the year ending October 31; (3) a daily record of the readings of the barometer and attached thermometer; (4) a summary of the pressure, temperature, dew-point, relative humidity, precipitation etc., for the past 3 years; and (5) the mean temperature at several different localities in the State. The summary for the year at the station (Logan) is as follows: Average air pressure, 24.96; highest temperature, 98° F. (July 19); lowest, −10° (February 1); mean, 46.82°; relative humidity, 60.22; dew-point, 47.42; precipitation, 14.51 in.

"The year is remarkable for the coldness of the month of February and the lateness of the spring, farm work being fully 2 weeks later than in 1892. The month of December was unusually mild, and somewhat made up for the low average of February.

"The precipitation for the year amounted to 14.51 in. The summer months, or growing months, were extremely dry, and this, with the lack of heat in the spring, rendered the season very unfavorable to agriculture, especially to dry farming."

Meteorology, practical and applied, J. W. MOORE (*London: F. J. Rebman, 1894, pp. 445, illd. Part 1 of a sanitary series*).—This is a treatise on meteorology in general, with applications in part 4 to sanitary matters and diseases, the latter part including only 50 pages. As a meteorology it is well and pleasantly written, and is noteworthy in the United States for containing the most complete account of the development and work of the meteorological service of the States which has yet been published. To this subject over 50 pages are devoted in the text, and in Appendix 1 is given a list of the regular stations of the United States Weather Bureau, and in Appendix 2 the more important publications of the United States meteorological service. Although printed in London, the book is adapted to the demands of the public in North America also.—M. W. HARRINGTON.

The sun and agriculture, with an appendix on the moon, F. HOUDAILLE (*Le soleil et l'agriculteur avec un appendice sur la lune. Montpellier: 1893, pp. 542; 82 illustrations*).—Professor Houdaille intimates in his preface that his title is "perfidious," and that it should read "Meteorological Ideas for Agriculturists," but that he chose the title used in order to have the book read. It gives a simple and interesting statement of the source and distribution of light and heat and their relations to animal and vegetable life—as they were understood 10 or 15 years ago. Lunar influences are discredited. The book is attractive in appearance and style, and a similar book (but fresher and less diffuse) might serve a good purpose in English.—M. W. HARRINGTON.

The drought of 1893 and its causes, A. FORTIN (*Sécheresse, 1893, ses causes;*

Principes généraux de météorologie, 1893, pp. 121).—This little book treats of the drought in France in 1893, and attempts to show its causes. The latter are looked for outside the earth, especially in the sun and sun spots.—M. W. HARRINGTON.

The Sahara, H. SCHIRMER (*Paris: 1893, pp. 440*).—A discussion of the Sahara from the standpoint of its utilization for commerce and agriculture. The author discusses especially the causes of the existence of the Desert of Sahara, and finds that those to which it has heretofore been attributed are not sufficient. After a thorough discussion of the climate and its changes during the year, he decides that the causes of the existence of the desert are purely atmospheric. He finds that a relative high pressure exists over the desert in winter, causing outflowing winds, except in the extreme northwest, where there is a current of inflowing winds, which must, however, cross the elevated Atlas range of mountains and thus be dried up before it can attain the interior of the desert. In summer the desert is occupied by a relatively low area of pressure, and while this causes inflowing winds from moist areas outside, yet the low pressure itself is due to heat, and this heat decreases the relative humidity of the inflowing air, until much precipitation is generally impossible. He notes, however, that there is probably no part of the desert on which rain never falls, but that in many parts intervals of one or more years (sometimes as many as twenty), may pass without a rainfall. When in this region rain does fall it is likely to be of a torrential character. Over the south and over the mountain region of the center there is a tolerably regular rainfall in mid and late summer. Over the plains to the east and west of these mountains the rainfall is irregular and only occasional. Along the northern margin of the desert, especially in Algeria, a regimen of rainfall belonging to the Mediterranean is likely to occur, giving rains in spring and in late autumn, while September is very dry.—M. W. HARRINGTON.

Meteorological summary for August and September, 1894 (*Massachusetts State Sta. Bul. 55, p. 1*).—Notes on the weather and tabulated summaries of observations on temperature, precipitation, and direction of wind.

Meteorological observations at the Massachusetts Hatch Station, C. D. WARNER and F. L. WARREN (*Massachusetts Hatch Sta. Met. Bul. 70, pp. 4*).—Daily and monthly summaries of observations at the meteorological observatory of the station for October. The weather conditions are briefly discussed with reference to their effect upon crops.

Meteorological observations at North Dakota Station (*North Dakota Sta. Rpt. 1893, p. 6*).—The maximum, minimum, and mean temperatures and rainfall for each month of 1892 and 1893 are tabulated.

Meteorological observations at South Dakota Station (*South Dakota Sta. Rpt. 1892, pp. 8*).—A reprint of Bulletin 31 of the station (E. S. R., 4, p. 243).

WATER—SOILS.

Nitrogen in rain water, R. W. ERWIN (*Utah Sta. Rpt. 1893, pp. 252, 253*).—Determinations of nitrogen as ammonia and as nitric acid in rain water collected at Salt Lake City during 1891, 1892, and 1893 are reported. The average amounts of nitrogen in these different forms supplied to an acre of land annually by rain water in Utah are calculated to be as follows: Nitrogen as ammonia, 5.06 lbs.; nitrogen as nitric acid, 0.36 lbs.; total, 5.42 lbs.

Investigations of Courland soils, G. THOMS (*Die erste kurländische Enquête-Reise, pp. 8*, and *Die zweite kurländische Enquête-Reise, pp. 28; excerpts from Land und forstw. Ztg., 1893, No. 28; 1894, No. 31*).—Accounts are given of two journeys to investigate the soils of the

Baltic provinces in continuation of studies, a report of which has already been abstracted (E. S. R., 5, p. 418). During the first of these tours, which lasted from June 15 to 25, 1893, 13 samples of soil from different localities were collected; and in the second, extending from June 23 to July 7, 1894, 13 other samples were collected.

The soils were all separated on the basis of their actual productive power into 3 classes—best, medium, and poor—before analyses were made. To what extent chemical analysis bore out the agricultural estimate is shown in the following table:

Average composition of Courland soils.

	Water.		Phosphoric acid.		Nitrogen.		Potash.		Lime.	
	Surface soil.	Sub-soil.	Surface soil.	Sub-soil.	Surface soil.	Sub-soil.	Surface soil.	Sub-soil.	Surface soil.	Sub-soil.
Best soil	10.05	15.21	0.17	0.12	0.15	0.07	0.31	0.40	0.48	0.46
Medium soil	11.27	12.84	.14	.09	.17	.07	.35	.51	.38	.37
Poor soil	11.29	10.07	.12	.07	.25	.06	.21	.25	.22	.16

The variations in the percentages of water are so irregular that no definite relations can be traced between the water content and the quality of the soil, except that the proportion of moisture is generally more uniform in the good soils than in the medium and poor soils. Another point illustrated with more or less clearness in these investigations is that clay soils retain moisture so much more tenaciously than sandy soils that on the former plants suffer from drought when the amount of water is not more than 10 to 14 per cent, while on the latter they thrive with percentages of water ranging between 6 and 9.

As in previous investigations, the percentages of phosphoric acid in both soil and subsoil stand in direct relation to the agricultural value. The percentages of phosphoric acid are invaribly lower in the subsoil than in the surface soil. This is due to the continuous fertilizing with phosphatic manures to which these soils have been subjected. The recommendation made in former articles that soils containing less than 0.15 per cent of phosphoric acid should be treated with phosphatic manures holds good for the soils examined in this case.

As regards nitrogen, the results of analyses appear to contradict the estimate based upon the actual productiveness. It will be observed that percentages are much higher for the surface soil than for the subsoil. This is ascribed to the system of culture pursued by which nitrogenous organic matter is accumulated in the upper layers of the soil. A study of the individual analyses shows that in many cases a high percentage of nitrogen accompanied a high water content. It is suggested that those soils which show a high percentage of nitrogen but are comparatively unproductive may be greatly improved by drainage or by heavy liming.

The percentages of potash seem to bear no definite relation to the quality of the soil, but it is interesting to observe that the subsoils are invariably richer in this element than the surface soils.

The percentages of lime vary uniformly with the productiveness of the soil.

Washed soils; how to prevent and reclaim them (*U. S. Dept. Agr., Farmers' Bul. 20, pp. 22, figs. 6*).—The nature and extent of water erosion of agricultural lands are popularly discussed, and the action of organic matter, humus, and lime in the soil in reducing washing is explained. The means described for preventing washing and for reclaiming gullied lands are deep plowing to increase absorptive power of soils, underdrainage, hillside ditches, terracing, reforestation, and covering with grasses or similar vegetation.

Soil moisture (*North Dakota Sta. Rpt. 1893, p. 6*).—Determinations of moisture in the surface soils at depths of from 1 to 3 in. and in the subsoil at depths of from 5 to 7 in. in a cultivated field on the college farm during 7 months (April to October) of 1892 and 1893 are reported.

Moisture of the soil, J. W. SANBORN (*Utah Sta. Rpt. 1893, pp. 94–98*).—The inconclusive results of moisture determinations in upper bench soil before irrigation, 2 days after irrigation, and 4 days after irrigation are briefly reported.

Marsh culture experiments conducted at the Royal Swedish Agricultural College in 1893, C. G. EGGERTY (*Kgl. Landt. Akad. Handl. Tidskr., 33 (1894), pp. 193–205*).

The exhaustion of soils by crops, L. GRANDEAU (*Jour. Agr. Prat., 58 (1894), No. 47, pp. 741–744*).—A reply to a correspondent, dealing especially with exhaustion of phosphoric acid.

FERTILIZERS.

On the preservation of manure, SCHMIDT and GERLACH (*Deut. landw. Presse, 21 (1894), No. 62, pp. 597, 598*).—In order to approximate as closely as possible conditions which obtain in practice large amounts (about 3,000 kg.) of manure were used in each of the experiments here reported, and the manure was exposed to the weather on a rubble floor underlaid by sand. Preservative materials were added as follows: (1) Peaty earth, 100 kg.; (2) kainit, 50 kg., and peaty earth, 100 kg.; (3) superphosphate-gypsum, 50 kg.; (4) "Vogel's preservative," 50 kg.; (5) precipitated phosphate, 50 kg., and (6) gypsum, 50 kg. The first experiment lasted from December 7, 1893, to April 16, 1894. None of the preservatives appreciably prevented the total shrinkage of the manures.

The kainit and peaty earth had little effect in preventing loss of nitrogen. Superphosphate-gypsum and gypsum were far superior to the other materials in this respect, the second giving slightly better results than the first. The losses were in all cases larger than those reported by Holdefleiss for similar experiments conducted during the drier fall season. The results of experiments by the authors at the same season confirm those of Holdefleiss. The difference is ascribed to the leaching out of the preservatives and the valuable constituents of the manure. The results in general indicate that whatever the preservative used it is of first importance to protect the manure heap from excessive moisture, which leaches out the valuable constituents and washes down the preservatives to the lower layers of the manure and thus prevents their effective action.

Nitrate marls of Egypt (*Amer. Fert., 1 (1894), No. 5, pp. 269–275*).—It appears from Egyptian Nitrate Mission reports that the material known as "Marog" and extensively used as a fertilizer in Egypt is "a foliated marl, greenish, and sometimes reddish gray, with veins of white gypsum and incrustations or small crystals of chlorid of sodium and some sulphate of sodium. . . . Its primary stratum has a depth of from 50 to 100 meters, and is horizontally bedded between the Lower Londinian, a hard white limestone of the Lower Eocene, a tertiary formation, and the Suessonian, a yellowish or grayish limestone; between the Lower Eocene and the Upper Cretaceous formation." Its geological age has not been definitely determined, but it is believed to belong to the Upper Suessonian.

The deposits crop out along the hills bordering the Nile Valley in Upper Egypt over an area of probably 30,000 square miles, and are believed to be practically inexhaustible.

When exposed to the air these marls readily crumble to a fine powder, although at lower depths they are very hard, tenacious, and strong. If not already abundant, nitrites and nitrates soon appear in considerable amounts on exposure to the air. As there is believed to be no organic matter present for microörganisms to work on, it is claimed that we have here an interesting and novel illustration of nitrification without the interference of organic matter. A suggested explanation of this phenomenon is "that the chlorid of sodium in the rock is dissolved by the humidity of winter or of high Nile, and is drawn out by capillarity and by dry air acting as a pneumatic machine. This chlorid of sodium is decomposed and decomposes the water. The oxygen of the water combines with the nitrogen of the air to form nitrous, and afterwards nitric, acid. This combines with the sodium to form sodium nitrate. The chlorid of ammonia which is also formed is volatilized."

The analyses reported show the better quality of these marls to contain from 8.82 to 11.77 per cent of nitrogen calculated as nitric acid. Many which are of poor quality when first exposed become rich in a comparatively short time. Experiments looking to the extraction and purification of the nitrate for the market are briefly alluded to.

Phosphate deposits of Algeria, C. T. GRELLET (*U. S. Consular Rpt. 1894, Nov., pp. 365–367*).—The existence of large deposits of phosphate in the western part of Tunisia has been known since 1886. Within the last two years similar deposits have been discovered in the Department of Constantine (eastern Algeria), in the Djebel Dyr, in the Djebel Kouif, and at Kissa, in the region of Tebessa, about 155 miles south of Bône. The Tebessa deposits cover several hundred square miles and are said to be almost inexhaustible. The phosphate, composed cheifly of bones and teeth of sharks, "is found in a semipulverulent state in strata from 0.5 meter (20 in.) to 3 meters (10 ft.) thick, intercalated in white marl and siliceous limestone. Its grade aver-

ages from 60 to 70 per cent and at places reaches as high as 85 per cent of tribasic phosphate of lime. Owing to the character of the deposit the mining of the phosphate is exceedingly easy and cheap."

The deposits are being exploited by English companies at all three of the above-named localities. "The general output of these mines was about 5,000 tons in 1893. It will reach at the very least from 30,000 to 35,000 tons during the current year. . . . Beds of phosphate have also been found in other parts of the colony in the Department of Oran, in the region of the Rio Salado, close to the boundary of Morocco, and at Inkermann (Oued Riou), 245 kilometers (157.8 miles) east of Oran;" but the deposits are of a different character, being in the form of solid rock and of a lower grade than those of Tebessa. "It can not be doubted that in the near future the North African phosphates will prove serious competitors in the European markets with our American fertilizers."[1]

Production of potash salts in Germany, F. H. MASON (*U. S. Consular Rpt. 1894, Oct., pp. 147–152*).—The history, nature, and extent of the natural deposits of potash salts at Stassfurt and Leopoldshalle, Germany, are briefly discussed, and the apparatus and processes used in preparing refined salts from the crude minerals are described. The latter industry is now practically under the control of a single company, "Verkaufs Syndikat der Kaliwerke," with offices at Stassfurt. Its principal works are at Stassfurt, Leopoldshalle, Westeregeln, Loederburg, Aschersleben, Thiede, Bernburg, and Vienenburg. The actual sales of crude salts and refined products during 1892 were as follows:

	Tons.
Crude salts:	
Rock salt	293,400
Carnallit	736,750
Kieserit	5,782
Schoenit	40,689
Sylvinit	32,669
Kainit	545,084
Refined products:	
Muriate of potash	114,311
Sulphate of potash	15,465
Sulphate of potash-magnesia	12,550
Manure salts	8,296

Of the crude salts carnallit, kainit, kieserit, and sylvinit are used both in a raw and pulverized state as fertilizers, and for the manufacture of concentrated salts. Kainit, partially freed from rock salt and other impurities, is the salt most generally employed for the first purpose and carnallit for the second. More than 700 tons of the latter were consumed in the refineries of the Stassfurt syndicate in the manufacture of refined salts during the past year. The number of

[1] For a brief discussion of the geology and chemistry of the phosphate deposits of Algeria, see E. S. R., 5, p. 933.

persons employed in this work, including miners, manufacturing laborers, chemists, engineers, clerks, etc., is about 10,000.

"The degree of practical interest which may attach to this subject now or in future, from the American standpoint, will depend largely upon whether there remain undiscovered in our country deposits of potash minerals which may lead to the establishment of similar industries, and in the end render American farmers and other consumers of potash salts independent of imported supplies. . . . To quote the opinion of a leading European expert: 'Not until the substrata which lie beneath all the principal American salt beds have been explored to a depth of at least 3,000 ft., will it be definitely known whether or not nature has stored on the Western Continent a supply of potash adequate and fitted to complete the trinity and balance the nitrates of Chile and the phosphates of the Florida peninsula.'"

Plan for better and simpler commercial fertilizers, C. W. DABNEY, Jr. (*Amer. Fert.*, *1* (*1891*), *No. 5*, *pp. 259–263*).—The object of this paper is stated to be "to direct attention to sources of the abuses which are doing the legitimate fertilizer trade so much harm and put interested persons to thinking about a sensible plan for preparing, advertising, and selling commercial fertilizers."

The chaotic system of naming fertilizers in vogue is strongly deprecated and it is urged that "commercial fertilizers should be mixed and branded after some more uniform method, so that they may become easily recognized and thoroughly understood articles of commerce, like ordinary chemicals or manufactured products." It is explained at some length that there is no sound basis for considering a manure containing available phosphoric acid, ammonia, and potash in the proportion of 8, 3, and 2 as the best "complete" fertilizer. There is good reason for believing that phosphoric acid fertilizing is overdone and that the proportion of phosphoric acid in common fertilizers should be reduced and that of potash increased. A basis for mixing fertilizers embodying these ideas is given and a simple system of naming fertilizers is described.

Methods of manuring, J. W. SANBORN (*Utah Sta. Rpt. 1893*, *pp. 157–163*).—The experiments with barnyard manure on different cereals commenced in 1892 (E. S. R., 5, p. 34) were continued during 1893.

The results of tests of different methods of application show that plowing under 6 to 7 in. deep is preferable to applying as top-dressing and that spreading on the surface in the winter is more beneficial than top-dressing and harrowing in. Observations on the temperature of sandy loam, unmanured and manured by different methods, showed that the soil was warmest where no manure was applied, next warmest where it was applied wholly on top.

As in previous experiments, unhoused manure gave slightly better results than housed, "but the figures are so close that they are within the limit of error or slight variation. The probable facts are that we do not have rain enough here to leach the manures to any considerable extent."

In comparative trials of manure from hogs, sheep, and horses on wheat and oats, the best results were obtained with the hog manure,

although there was little difference in effect between the three kinds. "For the year 1893, when the effect of the previous application was under test, sheep manure gave a larger yield than the other manures."

Solid manure alone proved inferior to the mixed solid and liquid excrement on the same crops.

As in previous trials on the sandy loam soil of the station, unfermented manure gave better results than fermented.

Fertilizer experiments at Mustiala Agricultural College during 1892, A. RINDELL (*Mustiala Agl. College Rpt. 1892, pp. 1–21*).—*Experiments with kainit.*—Hay and oats were grown on eighth and quarter acre plats fertilized with Thomas slag and varying quantities of kainit, one plat in each series being left unfertilized. Taken 20 cm. deep the soil on the plats weighed 1,492,800 kg. per hectare (1,330,000 lbs. per acre), 721,080 kg. of which was dry substance. The latter contained 64.53 per cent mineral matter, 1.058 per cent nitrogen, 0.074 per cent phosphoric acid, 0.770 per cent lime, and 0.139 per cent potash. The yields obtained were very low for both crops, and the application of fertilizers was not profitable in case of the hay. With the oats, however, the fertilizers gave a profit owing to the higher money value of the crop. The oats lodged where the heavier kainit fertilization was applied, but it is believed this may be remedied by the addition of more slag.

Experiments with bone meal and Thomas slag.—Taken 20 cm. deep the soil on the plats used for these experiments weighed 1,007,600 kg. per hectare (897,720 lbs. per acre), 430,400 kg. being dry substance. The latter contained 46.62 per cent of mineral matter, 1.567 per cent of nitrogen, 0.068 per cent of phosphoric acid, 0.088 per cent potash, and 1.130 per cent lime. Oats were used for the experiments, bone meal and Thomas slag being compared with one another when applied with kainit. Besides Thomas slag and kainit two plats received "sugar skimmings" in such quantities that the nitrogen supplied equaled that of the bone meal. The summer of 1892 was unfavorable to crops, heavy rains causing the oats to lodge in many places. The main results obtained are given in the following table, each figure given being the average for two plats.

Results of experiments with fertilizers on oats.

Fertilizer applied per plat of ⅛ acre.	Yield.		Relative yield.	
	Grain.	Straw.	Grain.	Straw.
	Kg.	*Kg.*		
None	69.0	94.2	100.0	100.0
25 kg. kainit	83.2	111.2	120.6	118.0
Do 13.1 kg. bone meal	89.8	115.0	130.1	122.1
25 kg. kainit 18.4 kg. Thomas slag	96.2	138.1	139.1	146.6
25 kg. kainit 18.4 kg. Thomas slag 4 kg. "sugar skimmings"	91.5	136.0	132.6	144.4

Pot experiments with phosphoric acid of different origin.—The comparative value of superphosphates, bone meal, and basic slag for barley was studied in these experiments. The basal fertilizer consisted of Chile saltpeter and "patent kali-magnesia," with a surface fertilization of 2 gm. of saltpeter, the fertilizers being applied at the rate of 188 lbs. of nitrogen, and 182.5 lbs. of potash per acre. Four kinds of bone meal were used in the experiments, viz, (1) sifted raw bone meal; (2) unsifted raw bone meal; (3) partially steamed bone meal extracted with benzin, fine sifted through normal sieve; and (4) same, coarser sifted through a $\frac{1}{4}$ mm. sieve.

Cylinders 3.28 ft. deep, 1.8 ft. in diameter, were used for the experiments. The soil in the cylinders, prepared from 3 parts of subsoil and 1 part humus soil, was watered from below by means of a tube extending to the bottom of the cylinder and terminating in a pipe $1\frac{1}{2}$ in. in diameter, provided with a number of holes. The pipe was covered with a drainage tile, on the top of which was placed a 6 in. layer of fine gravel (5 to 10 mm.); then came a 4 in. layer of coarse sand (1 to 2 mm.), above which the experimental soil proper was placed. The subsoil and humus soil used contained the following quantities of fertilizing ingredients: Nitrogen 0.033 and 0.047 per cent, phosphoric acid 0.092 and 0.095 per cent, potash 0.064 and 0.065 per cent.

Barley seed previously sprouted was planted 1 in. deep, and 180 cc. of water added to each cylinder. Three parallel experiments were made in each case. The average yields of barley obtained and the quantities of water required for producing 1 gm. of dry matter in each case are given below. The figures in the last columns are corrected for surface evaporation of water, which, according to Hellriegel, was estimated at 15 gm. per square centimeter for the fertilized cylinders during the whole experiment (100 days), and 20 gm. for the unfertilized cylinders.

Results of pot experiments with barley.

Fertilizer.	Phosphoric acid in fertilizer per hectare.	Number of developed heads.	Number of undeveloped heads.	Total number of heads.	Yield of barley.	Water required per 1 gm. of substance.
	Kilograms				*Grams.*	*Grams.*
None	....	57	9	66	61.5	750
Basal fertilizer	....	61	16	77	71.2	483
Superphosphate	50	85	29	114	239.5	335
Do	100	97	22	119	222.2	342
Do	150	122	15	137	285.8	272
Thomas slag	50	66	22	88	144.1	411
Do	100	87	18	105	190.1	360
Do	150	99	18	117	227.5	298
Bone meal 1	50	87	25	112	251.6	305
Do	100	129	30	159	353.0	348
Do	150	130	26	156	345.0	265
Bone meal 2	100	76	22	98	195.8	399
Do	150	93	24	117	221.6	345
Bone meal 3	50	87	23	110	201.7	371
Do	100	104	22	126	282.3	306
Do	150	114	18	132	240.7	305
Bone meal 4	50	69	31	100	187.6	369
Do	100	85	23	108	202.2	346
Do	150	96	12	108	203.4	359

The conclusions drawn from the experiments are as follows:

(1) The influence of the bone meal is largely dependent on its degree of fineness.

(2) Raw bone meal may, if very fine, give even better results than extracted bone meal.

(3) Thomas slag is more inferior to bone meal in its effects than is bone meal to superphosphate.—F. W. WOLL.

Manures, their management and use, E. M. SHELTON (*Queensland Dept. Agr. Bul. 3, (2d ser.), pp. 38, figs. 3*).—A popular discussion of the fertilizer resources and requirements of soils, green manuring, barnyard manures and their application, and the use of commercial fertilizers with special reference to Queensland conditions.

Barnyard manure, W. H. BEAL (*U. S. Dept. Agr., Farmers' Bul. 21, pp. 32, figs. 7*).—A popular discussion of the nature, value, management, and use of barnyard manure.

Algerian phosphates (*Amer. Fert., 1 (1894), No. 4, pp. 221, 222*).

The phosphate industry in the Anthony region, Florida, T. R. BAKER (*Amer. Fert., 1 (1894), No. 5, pp. 281, 282*).

Geographical position of the Florida phosphate belt (*Amer. Fert., 1 (1894), No. 1, pp. 34–37, figs. 2*).

The phosphates of Florida, P. M. DE LEON (*Amer. Fert., 1 (1894), No. 4, pp. 202, 203*).

The Florida phosphates, S. S. PEACOCK (*Amer. Fert., 1 (1894), No. 3, pp. 137–142*).

South Carolina phosphates (*Amer. Fert., 1 (1894), No. 2, pp. 98–100*).—Shipments and consumption.

The phosphates of Tennessee, N. P. PRATT (*Amer. Fert., 1 (1894), No. 1, pp. 9–17, figs. 4*).—These phosphates are here considered from the geological, chemical, and commercial standpoints.

The Tennessee phosphates, T. C. MEADOWS (*Amer. Fert., 1 (1894), No. 4, pp. 209–212, 1 map*).

Tennessee phosphates, E. DE W. SMITH and T. C. MEADOWS (*Amer. Fert., 1 (1894), No. 5, pp. 264–268, 282–284, illustrated*).—Brief statements regarding the phosphate industry in this State, quality of phosphate shipped, transportation facilities, possible extent of the deposits, etc.

Phosphates and fertilizers, E. H. WILLIS (*Amer. Fert., 1 (1894), No. 5, pp. 290–292*).—A brief review of the present condition of the phosphatic industry in South Carolina, Florida, Tennessee, Algiers, Tunis, and other foreign countries.

Chile saltpeter, S. S. PEACOCK (*Amer. Fert., 1 (1894), No. 4, pp. 195–201*).—Uses, methods of extraction, and comparative value are discussed.

The rôle of organic materials in soil and fertilizers, J. CORGNET (*Ann. Soc. Agr. sci. et ind. Lyon, 1 (1893), ser. 7, pp. 485–494*).

Liebig's flesh meal and its high value to agriculture (*Ztschr. landw. Ver. Hessen, 1894, No. 46, pp. 379, 380*).

Chemical effects of fertilizers (*Amer. Fert., 1 (1894), No. 5, pp. 294, 295*).—General statements regarding the action of fertilizers in setting free insoluble plant food in the soil.

Notes on the use of commercial fertilizers (*Fühling's landw. Ztg., 43 (1894), No. 22, pp. 705, 706*).—General notes based on the work of Maercker, Wagner, and others.

Recent experiments in fertilizing with lime and in associated lines (*Wochenbl. pom. ökon. Ges., 24 (1894), No. 23, pp. 307–310; No. 24, pp. 319–323*).

A harmful effect of liming (*Ztschr. landw. Ver. Hessen, 1894, No. 45, p. 369; Landw. Wochenbl. Schles. Holst., 43 (1894), No. 49, p. 690*).

Potash vs. sodium compounds as fertilizers, H. J. PATTERSON (*Md. Farmer, 1894, Sept., pp. 34, 35*).—A concise summary of the scientific evidence that soda can not replace potash as a plant food.

Nitrate of potash vs. nitrate of soda (*Southern Planter, 55 (1894), No. 10, p. 492*).—Brief reference to experiments of Maercker, which have indicated the superiority of nitrate of potash over nitrate of soda.

Availability of phosphoric acid, H. J. PATTERSON (*Md. Farmer, 1894, Sept., pp. 33, 34*).—A brief popular discussion of the availability of phosphoric acid in soils and fertilizers.

Relative values of different phosphates, of different forms of lime, and of sulphate and muriate of potash, C. SCHREIBER (*Rev. Agron. Louvain, 3 (1894), No. 2, pp. 92–102*).

Superphosphate and slag, their relative value, E. SAILLARD (*Jour. Agr. Prat., 58 (1894), No. 44, pp. 794–798*).

The economy of Thomas slag and kainit as fertilizers for meadows (*Sächs. landw. Ztschr., 42 (1894), No. 45, pp. 537, 538*).

The variation in value of different kinds of ground Thomas slag, LOGES (*Sächs. landw. Ztschr., 42 (1894), No. 43, pp. 515–517*).

Guano deposits (*Amer. Fert., 1 (1894), No. 5, pp. 292, 293*).—Brief notes on guano in general and on the various deposits which have been exploited, especially bat or cave guano found in the West Indies and in some localities in this country.

Adulteration (agricultural fertilizers and feeding stuffs), F. H. CRIPPS-DAY (*London: Stevens & Sons, Limited; noticed in Analyst, 19 (1894), Dec., p. 287*).

Analyses of commercial fertilizers (*Massachusetts State Sta. Bul. 55, pp. 2–8*).—A schedule of trade values of fertilizing ingredients and tabulated analyses of 112 samples of fertilizing materials, including mixed fertilizers, bone, nitrate of soda, cotton-seed meal, sulphate of potash and magnesia, muriate of potash, wood ashes, swill ashes, muck, soot, residue from water filter, and vegetable mold.

Aanlyses of commercial and special-formula fertilizers, H. J. WHEELER and B. L. HARTWELL (*Rhode Island Sta. Bul. 29, pp. 45–55*).—Analyses and valuations of 40 brands of commercial fertilizers and 6 samples of home-mixed fertilizers are tabulated, and the relative economy of home-mixed and factory-mixed fertilizers is discussed. The results of practical experience of farmers in home-mixing are reported to be very favorable to the practice.

FIELD CROPS.

The chemical development and value of red clover, H. SNYDER (*Minnesota Sta. Bul. 34, pp. 17–33*).

Synopsis.—The yield of dry matter was largest at the end of flowering, and of protein a little earlier. A crop of 4,360 lbs. of clover hay removed from the soil 66 lbs. of potash, 28.4 lbs. of phosphoric acid, and 76.4 lbs. of lime. At the time of full bloom the roots on an acre weighed approximately 1,760 lbs., containing 39 lbs. of nitrogen, 26.7 lbs. of potash, 27.8 lbs. of phosphoric acid, and 23.6 lbs. of lime. Clover when only 5 to 7 in. high constituted a valuable green manure. Failure of clover on certain soils was not due to want of plant nutrients.

Samples were taken at 5 different stages of growth: (1) When the clover was 5 to 6 in. in height, and before the flower head appeared; (2) 24 days later, when clover was in early bloom; (3) 14 days later, when clover was a little past full bloom; (4) at the end of the flowering period; and (5) when the clover was ripe. The maximum yield of dry matter occurred at the end of the flowering stage, the maximum yield of nitrogenous matter at the time of full bloom. Taking these maxima as 100, the amounts of dry matter and of nitrogenous matter

in the plant at different stages are represented by the following numbers:

Percentages of total crop of dry matter and nitrogen at different stages.

	Flower head invisible.	Early bloom.	Full bloom.	End of flowering.	Maturity.
Dry matter	9	31	97	100	97
Nitrogenous matter	15	37	100	96	94

Of the total nitrogen the albuminoids constituted in the first period 67 per cent, in the second 70 per cent, in the third 88 per cent, in the fourth 85 per cent, and in the last 83 per cent.

"The clover hay cut at the time of full bloom contains the largest amount of nitrogenous material in the most valuable food forms, while clover cut at the end of flowering contains the largest amount of dry matter, which is poorer in the valuable nitrogenous compounds. . . .

"Lime and potash are taken up by the plant the most rapidly of any of the the mineral matters. Only 2 per cent of mineral matter is added to the crop after full bloom. No potash is taken up after full bloom, and when ripe the plant contains less potash than at the time of full bloom. . . .

"In the first periods of clover the mineral matter is taken up somewhat in advance of the formation of organic matter, while in wheat the nitrogen and separate ash elements are assimilated much earlier in the development of the plant."

A crop of 4,360 lbs. of field-cured hay growing on an acre removed from the soil 66 lbs. of potash, 76.4 lbs. of lime, and 28.4 lbs. of phosphoric acid. As fertilizers for clover, gypsum and wood ashes are recommended by the author.

Proximate and ash analyses give at different stages the percentages of dry matter of the clover plant (exclusive of roots), of leaves, and of stems. The percentages of crude protein in the leaves for the first three stages were respectively 30.68, 27.38, and 19.37; in the stems at corresponding stages the percentages of crude protein were respectively 13.44, 11.25, and 11.26. The leaves at all stages were richer in potash and poorer in lime than the stems. Since the leaves contain about two-thirds of the nitrogenous matter of the plant (exclusive of roots), it is important that the loss of leaves in harvesting be avoided.

The weight of clover roots on an acre yielding 4,000 lbs. of hay was at the time of full bloom approximately 1,760 lbs. This weight of roots contained 39 lbs. of nitrogen, 26.7 lbs. of potash, 27.8 lbs. of phosphoric acid, and 23.6 lbs. of lime. The 39 lbs. of nitrogen, a large part of which was derived from the atmosphere, if purchased in commercial fertilizers would cost \$6.63.

If the young clover had been plowed under at the first stage of growth, May 9, "which would have been sufficiently early in this latitude for planting corn," the clover on an acre would have furnished to the corn crop 21 lbs. of nitrogen, worth \$3.15, besides changing into more available form 6.5 lbs. of phosphoric acid and 16 lbs. of potash.

Root nodules were found to be especially rich in nitrogen.

"In one case the light colored and active nodules contained 5.55 per cent nitrogen, while the dark colored and older ones from the same plants contained 3.21 per cent. . . .

"The mixed nodules, both active and inactive, from another lot of plants contained 4.60 per cent nitrogen, while 100 parts of the entire roots contained 2.21 parts of nitrogen."

Proximate and ash analyses of clover grown in different parts of the State are tabulated. From the results of these analyses and of soil analyses reported in Bulletin 30 of the station (E. S. R., 5, p. 857), the writer concludes that the failure of clover on certain soils is due rather to the want of proper mechanical condition of the soil than to the absence of any chemical constituent.

Clover sown with wheat gave a much larger yield than that seeded with oats.

Experiments with barley at Mustiala, 1892, G. GROTENFELT (*Mustiala Agl. College Rpt. 1892, pp. 104–106*).—Analyses are given of 3 varieties of barley seeded and of the crops grown from the same, as follows:

Analyses of barley.

	Seed barley.					Harvested barley.				
	Moisture.	Ash.	Nitrogen.	Nitrogen in dry matter.	Protein.	Moisture.	Ash.	Nitrogen.	Nitrogen in dry matter.	Protein.
Fredriksen's barley	11.80	2.24	1.99	2.21	13.81	10.34	2.37	1.56	1.74	10.88
Imperial barley	11.17	2.22	1.78	2.00	12.50	10.89	2.33	1.49	1.67	10.44
Chevalier barley	14.05	1.93	1.42	1.65	10.31	10.18	2.66	1.68	1.87	11.69
Averages	12.34	2.13	1.73	1.95	12.21	10.47	2.45	1.57	1.76	11.00

Similar differences in the composition of the seed and the product obtained are found here, as in case of the oat-culture experiments (p. 534).—F. W. WOLL.

Field experiments with corn, J. G. LEE (*Louisiana Stas. Bul. 29, 2d ser., pp. 1031–1040*).

Synopsis.—Tests of fertilizers and of varieties. Nitrogen in every form and at the rate of 18 and 36 lbs. per acre largely increased the yield of corn. Cotton-seed meal and cotton seed are recommended as the cheapest forms. The increase with phosphoric acid was very slight. Potash in every form and amount decreased the yield. Fractional applications of fertilizers slightly increased the yield resulting from a single application. The yields of 28 varieties are tabulated, Virginia White Gourd Seed leading.

In a special nitrogen experiment occupying 40 plats nitrate of soda, sulphate of ammonia, dried blood, fish scrap, cotton-seed meal, crushed cotton seed, green cotton seed, compost, and rotted cotton seed were compared. The quantities of nitrogen used per acre were 18 and

36 lbs. The average yields per acre of the plats are shown in the following table:

	Bushels.
Unfertilized plats	10.4
Nitrogen alone (average of all forms)	18.2
Superphosphate and kainit	12.3
18 lbs. nitrogen with superphosphate and kainit	20.3
36 lbs. nitrogen with superphosphate and kainit	23.0

Nitrogen in every form and amount largely increased the yield. Nitrogen in the form of cotton-seed meal and cotton seed (fresh, ground, and rotted) gave the best results and these materials are preferred and recommended because of economy and convenience.

The increased yield with phosphoric acid was very slight, and in some cases imperceptible. Small quantities of phosphoric acid are considered advantageous for corn. In a special experiment potash in every form, alone and in combination, resulted in an actual decrease of the crop.

Fertilizers were applied (1) all at planting, or (2) at planting and at last cultivation, or (3) at planting, second working, and last cultivation. The increase with 2 applications over 1 application was 1.3 bu.; of 3 applications over 1, 3 bu.; and of 3 applications over 2, 1.7 bu. per acre. "Concurrent results of previous years favor different applications of nitrogenous manures for corn on this soil."

Of 28 varieties of corn tested 28.4 bu. was the largest yield, made by Virginia White Gourd Seed.

Experiments with corn, R. J. REDDING (*Georgia Sta. Bul. 23, pp. 73–88*).

Synopsis.—Tests of fertilizers, subsoiling, intercultural fertilization, pulling fodder, cutting and shocking corn, varieties, composting, and detasseling. All of the fertilizer mixtures caused a financial loss. Subsoiling reduced the yield of corn. Fodder pulling yielded a slight net profit, although it reduced the yield of grain 3.52 bu. per acre.

Fertilizer experiments (pp. 75–77).—The basal fertilizer used consisted of 312 lbs. of superphosphate, 18 lbs. of muriate of potash, and 130 lbs. of nitrate of soda per acre, and cost $5.70. This resulted in a financial loss of $3.62 per acre; every increase in any fertilizing constituent of the mixture still further increased the loss. Although all combinations of fertilizers entailed a loss, nitrogen was more effective than phosphoric acid and potash.

"These results do not contradict those of previous years, but are confirmatory of the indication that Indian corn does not respond profitably to commercial fertilizers on the high, dry uplands of middle Georgia. They suggest that corn should always be planted as a part of a regular rotation on such lands, or confined in the main to low, moist, dark-colored (humus) soils. The experiments of previous years show that such fertilizers do pay on cotton and oats. It is therefore suggested, with confidence, that corn should follow a previously well-fertilized cotton crop, and should be lightly fertilized with a highly nitrogenous fertilizer, such as cotton seed (or meal), nitrate of soda, or with a compost of stable manure."

Subsoiling (pp. 77–79).—On red upland with hard red clay subsoil alternate plats were subsoiled and simply plowed. The preparation of the 2 series of plats was exactly the same except that in one set of plats the 1-horse turn plow, which broke the land to a depth of 5 in., was followed by the "subsoiler" running 5 in. deeper. The average yield of the subsoiled plats was 30.44 bu., of the plats not subsoiled 31.43 bu. per acre, a decrease of 0.99 bu. with subsoiling. There was a loss from subsoiling in each of the 7 pairs of fertilized plats; however, in the case of 2 unfertilized plats there was an increase of 3.09 bu. per acre from subsoiling.

Intercultural fertilization (pp. 79–81).—On corn fertilized at the time of planting with a complete fertilizer, 65 lbs. per acre of nitrate of soda was applied June 9. This application of nitrate of soda increased the yield by only 0.55 bu. per acre. The growth of crab grass was luxuriant on the fertilized plats and the yield obtained by mowing the grass among the stalks of standing corn was more than sufficient to pay for fertilizers used.

Pulling fodder (pp. 81, 82).—Pulling fodder (stripping the blades from the stalk) reduced the yield 3.52 bu. per acre. The yield of fodder was 665 lbs., which at 1 ct. per pound left a net profit after paying cost of stripping of $2.64 per acre.

"On 'fresh land,' or a soil abounding in vegetable matter (as bottom land), the injury to the corn resulting from stripping the blades is more than compensated by the net yield of fodder. On such soils the yield of fodder is generally larger, relatively to the yield of corn, than on old and thirsty soils, and a much larger amount can be 'saved' in a day.

"The results, one year with another, do not favor the pulling of fodder, as a general rule of farm practice; and it is only expedient under the most favorable circumstances.

"It is better to provide a crop of hay grass, or peavines, the mowing of which will generally be found much more profitable labor."

Cutting and shocking corn (p. 83).—At the time when the blades are usually pulled alternate plats of corn were cut and shocked. November 1 the corn was pulled from the cut stalks and from those still standing. The yield from cutting was 3 bu. per acre less than from leaving the stalks standing.

Varieties (pp. 83, 84).—Of 10 varieties tested the largest yield was made by Shannon Yellow.

Composting (pp. 85, 86).—The difference between making composts and applying the materials directly to the soil was only 0.69 bu. of corn per acre in favor of composting.

"Well rotted stable manure, crushed cotton seed (green), and acid phosphate, composted in the heap 47 days before using, are but a little more effective than the same quantity of the same materials, kept separate until just before planting, and then applied to the soil—not enough to pay for the extra labor of handling."

Detasseling corn (pp. 87, 88).—Alternate rows were detasseled; the yield on these was only 0.45 bu. of corn per acre greater than on the rows not detasseled.

Field experiments with corn, A. A. MILLS (*Utah Sta. Rpt. 1893, pp. 236–249*).—These consisted of tests of varieties, of thick and thin planting, and of detasseling. Of the varieties grown 3 years the common white flint of the locality gave the largest average yield. Thick and thin planting gave almost identical results. Every alternate row of corn was detasseled. These rows gave a smaller yield than the alternate rows not detasseled.

Methods of cultivating corn, J. W. SANBORN (*Utah Sta. Rpt. 1893, pp. 131–139, 150–157*).—Eight plats were cultivated at different depths. The results seem to favor shallow culture. Temperatures and percentages of moisture for the soil of the different plats are tabulated. "The plats shallow tilled had a lower temperature than those deep tilled. . . . More water was retained in the soil on the plats deep tilled. . . . This gain, however, was confined to the lower areas from 4 to 8 in. deep."

Experiments bearing on drilling and checking corn gave results not entirely conclusive. Determinations of soil temperature and of moisture in the different plats are tabulated. "Corn that was tilled flat gave the warmest soil between the rows, and as it gave rather the largest crop, it is not improbable that there is a connection between the two facts."

Why pull your corn fodder? F. E. EMERY (*North Carolina Sta. Bul. 104, pp. 263, 264*).—In 1893 the amount of dry matter in different parts of the corn plant was determined at the time when the ears of corn were "from thick milk stage to nearly ripe." Of the total dry matter produced on 1 acre the ears contained at that time 19.85 per cent, the husks 6.81 per cent, the leaves 20.66 per cent, and the stalk 52.68 per cent. Of the total dry matter on 1 acre the ears contained 1,503.88 lbs., the husks 515.59 lbs., the leaves 1,565.08 lbs., and the stalks 3,990.25 lbs. The author recommends the cutting and shocking of corn so as to secure the greatest amount of forage.

Field experiments with cotton, R. J. REDDING (*Georgia Sta. Bul. 24, pp. 109–123*).

Synopsis.—The experiments are classified as follows: (1) Variety test, in which Duncan gave the largest yield; (2) distance experiments; (3) a general fertilizer test, the best complete fertilizer being 468 lbs. superphosphate, 36.4 lbs. muriate of potash, and 130 lbs. nitrate of soda per acre; and (4) an experiment in plowing under pea vines at different stages of growth as a green manure for cotton, in which results were favorable to mature pea vines.

Test of varieties (pp. 109–114).—Seventeen varieties of cotton were tested. The yield at each picking, number of bolls to a pound of seed cotton, number of seeds in 1 lb., total yield of lint and seed, per cent of lint, and value of lint and seed are tabulated. Duncan gave the largest yield of seed cotton (2,285 lbs. per acre) and Dearing Small Seed the largest percentage of lint (36.3). The earliest varieties were King and Hawkins; those having largest bolls, Jones Improved and Truitt

Improved; those having smallest seeds, Hawkins and Stoney Hybrid. The results of this test suggest some correspondence between the total yield and the earliness of the variety.

Distance experiments (pp. 114–117).—In rows 4 ft. apart the stalks were planted at distances of 1, 2, 3, and 4 ft. The largest yield (1,925 lbs. of seed cotton per acre) was obtained when the distance in the row was 3 ft. At distances of 4 by 1 ft. the average yield of seed cotton per plant was 0.275 lb.; when the plants were 4 by 2 ft. the average was 0.417 lb. per plant; when the distance was 4 by 3 ft. the average was 0.561 lb., and when 4 by 4 ft., 0.69 lb. When only 6 sq. ft. were allowed for each plant the largest yield of seed cotton (1,964 lbs. per acre) was obtained by planting in rows 3 ft. apart, the plants standing 24 in. apart in the row. Every increase in the width of the row with a proportionate decrease in the distance of plants in the row reduced the yield per acre and per plant. The author concludes that in general the yield of cotton is larger in proportion as the space appropriated to each plant approaches a square. "It may be safely urged that land that will not produce the maximum crop of which it is capable with rows not less than 3 ft. wide can not be profitably cultivated in cotton."

Effect of increasing the amount of fertilizer (pp. 117–119).—A mixture of 1,476 lbs. of superphosphate, 115 lbs. muriate of potash, and 409 lbs. nitrate of soda was applied at the rate of 500, 1,000, 1,500, and 2,000 lbs. per acre. The yield of the unfertilized plat was 1,249 lbs. of seed cotton, of that receiving 500 lbs. of the mixture 1,631 lbs., and of that receiving 1,000 lbs. of the mixture 1,853 lbs. The yield with 1,500 and 2,000 lbs. of the fertilizer was practically the same as that with 1,000 lbs. When 500 lbs. per acre was used the financial gain was 79 per cent on the investment for fertilizers; when 1,000 lbs. was used, 41 per cent. The larger applications resulted in an absolute loss.

General fertilizer experiments (pp. 119–122).—In this experiment a mixture consisting of 468 lbs. of superphosphate, 36.4 lbs. of muriate of potash, and 130 lbs. of nitrate of soda per acre gave a larger yield of seed cotton (1,762 lbs. per acre) than any variation of this formula effected by increasing any of the separate constituents of the mixture. The formula just mentioned contains 10 per cent of available phosphoric acid, 3 per cent of potash, and 3 per cent of nitrogen, and is recommended by the author as the best.

Green manuring with cowpeas (pp. 122, 123).—The yields of seed cotton following cowpeas were as follows: When peas were picked and the vines plowed under, 1,873 lbs. per acre; when the peas were mowed and left on the surface to dry and later turned under, 1,849 lbs.; when vines were turned under green, 1,790 lbs.; when vines were made into hay and only the stubble plowed under, 1,731 lbs. In consideration of the value of the hay and of the peas it was found most profitable to make hay of the vines and plow under the stubble, and next to this to gather the ripened peas.

Field experiments with cotton, J. G. LEE (*Louisiana Stas. Bul. 29, 2d ser., pp. 1017–1031*).

Synopsis.—Tests of fertilizers, varieties, and distances. Every form of nitrogen was advantageous, cotton-seed meal taking the lead. Phosphates used alone increased the yield 248 lbs. per acre. The use of potash resulted in an abolute loss. Fractional applications of fertilizers were unprofitable. In distance experiments the largest yield was made by leaving 2 stalks in hills 24 in. apart in the rows.

Fertilizer experiments (pp. 1017–1029).—In a special nitrogen experiment on 35 plats 24 and 48 lbs. of nitrogen per acre were applied in the forms of nitrate of soda, sulphate of ammonia, dried blood, fish scrap, cotton-seed meal, crushed cotton seed, rotted cotton seed, and a compost of cotton seed, stable manure, and superphosphates. The average yields of cotton seed per acre were as follows:

	Pounds.
Unfertilized plats	680
Nitrogen alone	1,090
Superphosphate and kainit	776
24 lbs. nitrogen with superphosphate and kainit	1,113
48 lbs. nitrogen with superphosphate and kainit	1,328

The average per cent of increase over the yield of the mixed mineral plats was as follows: With cotton-seed meal, 99; fish scrap, 69; nitrate of soda, 49; dried blood, 42; crushed cotton seed, 40; sulphate of ammonia, 36, and rotted cotton seed, 32.

The average increase over the yield of the mixed mineral plats for the 2 mineral forms of nitrogen, nitrate of soda and sulphate of ammonia, was 42 per cent; for the 2 animal forms, dried blood and fish scrap, 55 per cent, and for the 3 vegetable forms, cotton-seed meal, crushed cotton seed, and rotted cotton seed, 57 per cent. "Concurrent results of 4 years now strongly indicate that on these soils 24 lbs. of nitrogen per acre is more profitable than larger quantities."

In a special phosphoric-acid experiment in which dissolved boneblack, acid phosphate, South Carolina floats, and Thomas slag were used alone and in combination with nitrogenous and potash fertilizers, the phosphates used alone on an average increased the yield over the unfertilized plats 248 lbs. of seed cotton per acre. However, the complete mixtures containing phosphates gave 86 lbs. of seed cotton less per acre than the mixtures from which the phosphates were omitted.

In a special potash experiment in which cotton-seed-hull ashes, kainit, muriate of potash, and sulphate of potash were compared the potash fertilizers used alone and in combination reduced the yield.

Shallow applications of fertilizers (2 or 3 in.) gave better results than deep applications.

Fractional applications of fertilizers were unprofitable.

Varieties (pp. 1029–1031).—The yields made by 33 varieties are tabulated. W. B. Ethridge Small Seed, Kolb Prolific, Cook Long Staple, Bancroft Herlong, and Gold Dust gave the largest yields of seed cotton.

Distance (p. 1027).—At distances of 8, 12, 16, 20, and 24 in. in the drill 1 and 2 stalks of cotton were left. In 1893 2 stalks in a place 24 in. apart gave the best results.

Variety tests and coöperative fertilizer experiments with cotton, J. N. HOOK (*South Carolina Sta. Bul. 18, n. ser., pp. 23*).—Of 14 varieties tested at the station in 1893, Truitt gave the largest yield of seed cotton, 1,660 lbs. per acre. The results of fertilizer experiments conducted at the station and in ten other localities within the State are tabulated. No conclusions are drawn. The bulletin contains notes on the history of cotton.

Experiments with cowpeas, H. N. STARNES (*Georgia Sta. Bul. 23, pp. 89–108*).

Synopsis.—Tests of fertilizers and varieties. Phosphoric acid gave best results both in the production of vines and of peas. The use of nitrogen and potash was not profitable. The black pea gave the largest yield of peas and of vines. In general the varieties making the heaviest growth of vines produced the largest yield of peas.

Fertilizer tests (pp. 89–103).—For this test there were used 51 plats with strong clay soil and stiff clay subsoil, "rather better than the average land, having been planted for 2 consecutive years previously in sweet potatoes." Whip-poor-will peas were sown in drills June 13. The peas were picked 3 times; on half of each plat the vines were cut and weighed August 30.

The yield and value of peas and vines and the profit and loss from applying fertilizers are tabulated and illustrated by diagrams. The yield of peas on the unfertilized plats averaged 12.24 bu. per acre; the green vines (entire plants) on the unfertilized plats averaged 10,270 lbs. per acre. The largest yield of peas, 16.56 bu. per acre, and the largest yield of vines, 16,328 lbs., were made by 360 lbs. of cotton-seed meal and 960 lbs. of superphosphate. The following are the author's conclusions:

"It is money thrown away to apply any form of nitrogenous fertilizer to cowpeas.

"The use of potash salts in any form appears unprofitable, large doses, especially of kainit, proving positively injurious.

"Complete fertilizers appear to be valuable only in direct proportion to the preponderance of phosphoric acid in the combination.

"Heavy applications of any form or combination of fertilizers, including phosphates, are unprofitable.

"Moderate doses of superphosphate, or Florida soft phosphate (ground rock, untreated), produce the largest gross yield as well as the greatest profit.

"The amount of phosphates which may be safely depended upon differs, of course, with the character of the land. The better the soil (in its mechanical composition as well as in its chemical contents) the greater the amount that may be used with profit. A range of from 200 to 400 lbs. per acre of acid phosphate and of perhaps double that amount of soft phosphate would probably cover all contingencies."

Varieties (pp. 104–108).—Twenty-two varieties of cowpeas were grown in rows 4 ft. apart. The maximum yield of green vines, 18,876 lbs. per

acre, and the maximum yield of peas, 14.67 bu. per acre, were made by the Black variety. For forage the leading varieties ranked as follows: Black, Matthews, Gourd, White, Taylor Prolific, Blue Hull, Speckled Crowder, and Rice and Clay. In yield of peas the order was as follows: Black, Matthews and Clay, Taylor Prolific, Blue Hull, Speckled Crowder, White Crowder, Mush, and Williams Hybrid.

Experiments with grasses and forage plants, R. L. BENNETT and G. B. IRBY (*Arkansas Sta. Bul. 29, pp. 127–136*).—In boxes 10 by 12 in. and 4 ft. deep filled with soil the relation between the dry weights of tops and roots of certain forage plants was as follows:

Relation between dry matter of tops and roots.

	Tops.	Roots.
Orchard grass	100	100
Timothy	100	83
Clover	100	106
Millet	100	51
Peas	100	73

With orchard grass 50 per cent of the roots was found in the first 12 in. of soil and 90 per cent in the first 20 in. Of timothy roots 50 per cent was found in the first 4 in. of soil, 95 per cent in the first 6 in., and none penetrated deeper than 12 in. Of millet roots 80 per cent were found in the first 12 in. of soil and 15 per cent between 12 in. and 3 ft. Clover roots were about equally distributed in the first, second, and third foot of soil. The roots of cowpeas were more abundant in the stratum of soil 12 to 18 in. below the surface and few cowpea roots went deeper than 2 ft.

Timothy and orchard grass were compared in a field experiment. Timothy seeded in March was killed by the drought of the following summer, while orchard grass made a good growth and a fair yield.

Experiments with grasses and forage plants, J. W. SANBORN (*Utah Sta. Rpt. 1893, pp. 44–52, 103–106*).—The yields of hay for 2 and 3 years and the height of plants at different dates are tabulated for the following forage plants: Orchard grass, timothy, tall fescue grass, rescue grass, reed canary grass, Hungarian brome grass, kidney vetch (*Anthyllis vulneraria*), tufted hair grass (*Aira cæspitosa*), burnet (*Poterium sanguisorba*), English rye grass, sainfoin, alfalfa, alsike clover, melilotus, goat's rue (*Galega officinalis*), red clover, wood meadow grass, sheep fescue grass, meadow fescue grass, Italian rye grass, tall meadow oat grass, redtop, Johnson grass, meadow foxtail, rough-stalked meadow grass, Kentucky blue grass, water meadow grass, various-leaved fescue grass, meadow brome grass, and pea-vine clover. The yield in dry matter was determined for most species. Among other forage plants grown were crimson clover, spurry, sulla (*Hedysarum coronarium*), *Panicum nigratum*, *Bouteloua racemosa*, and *Andropogon halli*.

Alfalfa gave the largest yield, followed in one field by red clover, in another by alsike clover. Special attention is called to sheep fescue and meadow foxtail as grasses for the West. Goat's rue averaged 4,490 lbs. of hay per acre; Hungarian brome grass, 2,245 lbs. per acre.

Hungarian grass, rye, sorghum, soja beans, sugar beets, mangel-wurzels, and carrots were also grown.

Varieties of grasses, J. W. SANBORN (*Utah Sta. Rpt. 1893, pp. 38–44*).—A number of pasture grasses were tested for grazing steers, with the result stated below:

"(1) In the above trial mixed pasture grasses proved superior in every respect to any single variety.

"(2) Alfalfa was next in value to the mixture in quantity of growth of grass, but gave less production of meat, being in this trial, as in others, seemingly less palatable than any other variety grown.

"(3) Of the other varieties there was very little difference between English rye grass, orchard grass, tall oat grass, and meadow fescue when the growth of animal and the growth of grass are both considered.

"(4) It is probable that the three pasture grasses on our dry uplands that are used in other sections of the country, meadow foxtail, blue grass, and redtop, are less valuable than either of the more rank growing grasses used in this experiment."

Grazing value of varieties of grass, J. W. SANBORN (*Utah Sta. Bul. 33, pp. 1–5*).—This is a continuation of the experiment mentioned above for about 1 month the following season.

"A mixture of pasture gasses proved very much superior for grazing steers to each one of the grasses sown singly.

"Of the single varieties tall oat grass leads, with timothy second and alfalfa third."

Field experiments with timothy, J. W. SANBORN (*Utah Sta. Rpt. 1893, pp. 53–64*).

Synopsis.—The results were in favor of slight preparation, slight tillage for the seed bed, rolling the seed bed, covering the seed rather deep, using more than 8 qt. of seed, and broadcast seeding. Both spring and fall grazing reduced the yield of hay, the former much more than the latter.

Plats were prepared by harrowing alone, and by plowing 4, 7, and 10 in. deep. The unplowed plat, prepared by harrowing only, gave the largest yields in 1892 and 1893. In another series of plats where different amounts of harrowing and dragging were given the yield of hay decreased as the amount of preparation increased.

Light and heavy seeds were sown. Light seed (that floating in brine) gave a smaller yield of hay in the first season, but an equal yield in the second year. Rolling the seed bed largely increased the yield of timothy hay.

On light loam soil, in an experiment not altogether conclusive, timothy seed covered deep gave better results than when covered very shallow.

The total yields of dry matter per acre for 1892 and 1893 from sowing

different amounts per acre of timothy seed were as follows: Eight qt. per acre, 2,846.94 lbs.; 16 qt., 3,732.08 lbs.; 24 qt., 3,928.14 lbs.; and 32 qt., 3,732.08 lbs. "I assume that for this poor soil 16 qt. is enough, and probably too much for a richer soil."

In 1892 the yield of dry matter on a plat sown broadcast was 3,720 lbs. per acre; on a drilled plat, 2,342.32 lbs. In 1893 the yield on the broadcast plat was 2,907.56; on the drilled plat, 2,028. This trial favored broadcast seeding, but the amount of seed used is not stated.

The timothy meadow used in the following experiment had been seeded 2 years. A plat of three-eighths of an acre was grazed by 2 heifers for 14 days, beginning November 8. A similar plat was grazed May 16 following by 18 head of cattle. Another plat was not grazed at all.

The yields of dry matter per acre at the next harvest were as follows: On the spring-grazed plat, 2,682.81 lbs.; on the fall-grazed plat, 4,287.36 lbs.; and on the plat not grazed, 4,630.88 lbs.

Drilling vs. broadcasting timothy seed, J. W. SANBORN (*Utah Sta. Bul. 33, pp. 6–8*).—Both in 1892 and 1893 drilled timothy gave a slightly larger yield of hay than broadcasted, the average yield per acre for the 2 years being 1,767 lbs. of hay from broadcasting and 1,900 lbs. from drilling. The average amount of moisture at different dates was 12.25 per cent on the plats broadcasted and 11.13 per cent on the drilled plats. The average temperature of the soil of the 2 plats was practically identical.

The effect of quicklime on the growth of leguminous plants, SALFELD (*Deut. landw. Presse, 21 (1894), No. 83, pp. 785, 786*).—The soil used for these experiments was a deep, poor sand, in cultivation for a long time. In the summer of 1893 it received a liberal application of kainit and Thomas slag; in addition half the field was given a broadcast application at the rate of 1,800 lbs. quicklime, the other half was treated with marl in such quantity as to furnish the same amount of lime as the quicklime. Then the field was plowed and harrowed; in November it was again plowed and subsoiled. In February, 1894, the plats intended for field peas (*Pisum arvense*) and garden peas (*P. sativum*), on both the limed and marled portions of the field, were inoculated with earth from an old pea field. Later both kinds of peas, 2 species of lentils, and *Lathyrus clymenum* were sown in drills. For the last 3 species no inoculation was made.

The weather up to the middle of May was dry, and up to this time there was no difference in the appearance of the plants fertilized with lime and with marl. After this date the rainfall was plentiful.

By the middle of July the plants on the marled plats were luxuriant and green; those on the limed plats were, with few exceptions, yellowish. On examining the roots it was found that the yellowish plants had no root tubercles; the green plants on the limed plats had many

root tubercles. Only three of the crops were gathered; their yields of seed in pounds per acre was as follows:

Yield of peas on marled and limed soils.

	Marled.	Limed.
Garden peas (inoculated)	2,190	716
Field peas (inoculated)	2,325	1,218
Lentils	796	154

The other crops were not gathered, but their appearance also indicated injury from the use of quicklime.

The author's conclusion is that the failure to form root tubercles was the cause of the decrease on the limed plats, and that this was due to the destructive effect of the quicklime on the organism concerned in the fixation of atmospheric nitrogen.

In previous experiments with field peas and horse beans on sandy soil and "high moor," marl gave better results than quicklime, but the difference in their effects was never so great as in the above experiment. If for sandy soil poor in lime, marl can not be had, the author advises that quicklime be applied to the grain crop preceding the leguminous crop and not directly to the latter.

Soil inoculation for lupines, SALFELD (*Deut. landw. Presse, 21 (1894), No. 78, p. 745*).—On an old field where lupines had never before grown, lupine seed was sown in standing rye June 3, 1894. In the preceding February about 3,200 lbs. per acre of soil from a lupine field had been carefully and evenly scattered over the growing rye. About the middle of September it was noticed that about half the plants were dark green and well developed, while the remainder were reddish and small, presenting the same appearance as plants on virgin soil not inoculated. The weak plants grew among the strong and close to them. The strong plants had numerous root tubercles, the weak plants none. The author draws the lesson that earth for inoculation purposes should not only be evenly spread on the surface but should be mixed with the soil by the plow or harrow, in order that it may be so diffused as to influence every individual plant.

A chemical-botanical investigation of different varieties of oats at Mustiala, 1892, G. GROTENFELT (*Mustiala Agl. College Rpt. 1892, pp. 67–103*).—Forty-eight samples of oats, 28 of domestic (Finnish) and 20 of foreign origin, were grown at the college experimental grounds during 1892. The foreign samples came from the Scandinavian countries, from Germany, England, Scotland, and the United States. They included varieties of Welcome, New Zealand, Canada, Triumph, White Danish, Duppauer, Probsteier oats, etc. A part of the seed was subjected to chemical analysis, and examined as to germination, purity, etc. During the growing period notes were taken at least every other day concerning the stand of the different varieties. The influence of the climate on the varieties was thus carefully studied.

The average weight per 1,000 kernels and the per cent of kernel for the different groups of oats sown were as follows:

Weight of grains and per cent of kernel in oats.

	Number of samples.	Weight of 1,000 kernels.	Kernel.
		Grams.	*Per cent.*
North Finnish black oats	9	25.0	68.0
South Finnish dark oats	9	25.4	68.8
Black plume oats	2	27.5	69.0
White oats	8	29.0	72.0
Foreign samples	20	32.1	72.0

The author believes that the lighter weight of the Finnish oats is partly accounted for by less careful selection of seed, a larger proportion of inner kernels being found in these samples. The majority of the foreign varieties, unlike the Finnish samples, had been systematically improved at seed control stations, and were true varieties.

The Southern varieties, and especially the more improved ones among them, were poorer in ash and protein than the Northern varieties.

The soil used for the trials was fairly uniform, and was a light sandy soil, medium rich in humus. The seed of each variety was sown May 20 on one-twentieth acre plats, and the crop was harvested September 6 to 24. The average lengths of the growing periods and the yields of the different varieties and groups are given in the following table:

Length of growing period and yield of oats.

	Growing period.	Air-dried.			Kiln-dried.
		Unthreshed crop.	Straw.	Grain.	Grain.
	Days.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
North Finnish black oats	111.0	109.1	73.0	36.6	32.7
South Finnish dark oats	125.4	142.0	93.3	48.7	40.4
Black plume oats [1]	128.0	152.5	109.5	43.0	36.0
South Finnish white oats [1]	123.4	158.9	108.4	50.4	41.9
Foreign varieties [2]	126.0	146.2	99.6	47.2	38.8

[1] 1 variety not ripe. [2] 9 varieties not ripe.

The highest yielding variety was Sordavala. The average length of the growing period for oats at Mustiala has been 116 days for the last 10 years, while during 1892, owing to the cold season, it was 123 days.

In comparing the composition of the seed oats with that of the harvested crop there was found, as a general rule, a lower moisture and protein content and a somewhat higher ash content in the harvested crop. The average results were as follows:

Composition of seed oats and resulting crop.

	Moisture.	Ash.	Protein.
	Per cent.	*Per cent.*	*Per cent.*
Average of all analyses of seed oats	11.30	2.81	12.49
Average of all analyses of harvested oats	8.61	3.00	10.95
Difference in the harvested oats	−2.69	+.19	−1.74

In judging these results the somewhat abnormal character of the season must be borne in mind. The questions of the influence of the climate on the crop under more normal conditions and during cultivation for a series of years have yet to be studied.

The South Finnish white oat varieties lead in the amount of protein produced, with an average yield of 186.7 lbs. of protein per acre. The single variety yielding the largest quantity of protein per acre was Sordavala, 288 lbs.

Oats from different parts of the sheaf.—Oat kernels from different parts of the ear were analyzed, with the following results:

Weight and nitrogen content of oats from different parts of the ear.

	North Finnish black oats.		Triumph oats.	
	Weight of 100 kernels.	Nitrogen.	Weight of 100 kernels.	Nitrogen.
	Grams.	*Per cent.*	*Grams.*	*Per cent.*
Outer kernels	3.148	2.34	3.344	1.54
Middle kernels	2.475	2.54	3.046	1.65
Inner kernels	1.440	2.68	1.554	1.52
Average		2.52		1.57

—F. W. WOLL.

Experiments with Irish potatoes, E. S. RICHMAN (*Utah Sta. Rpt. 1893, pp. 181–190*).—These consisted of experiments with entire small potatoes as compared with cuttings of the same weight from large potatoes, depth of plowing, effect of manuring on starch content, and tests of 33 varieties. This is the fourth year of the experiment comparing small uncut potatoes with cuttings of equal weight from large potatoes. Each year the large seed tubers were selected from the crop propagated by cuttings and the small seed tubers from the crop propagated by uncut small tubers. The results in pounds per plat of one-twentieth acre for the 4 years were as follows:

Comparative yield of potatoes from cuttings and small tubers.

	1890.	1891.	1893.	1894.
Cuttings from large tubers	408	126	362	435
Small entire seed tubers	392	106	545	429

The differences due to character of seed were but slight.

Plowing to a depth of 6 in. gave, with potatoes, as also with cabbage and sweet corn, better results than deeper or shallower preparation.

The results of a comparison of the starch content of tubers grown on unfertilized plats and on plats manured at the rate of 35 and 70 tons of manure per acre are somewhat conflicting, but the author draws the conclusion that constant excessive manuring tends to decrease the amount of starch.

Irrigation of potatoes, E. S. RICHMAN (*Utah Sta. Rpt. 1893, pp. 179, 180*).—The yield of potatoes on an unirrigated plat, on a plat irri-

gated with 5 in. of water on June 29, and on plats irrigated with total amounts of water ranging from 14 to 17½ in., applied every third, fourth, fifth, sixth, seventh, and eighth day are reported.

The results show that the amount of water taken up by the soil did not depend upon the frequency of irrigation, and that the largest yield of merchantable potatoes was produced on the plat irrigated every eighth day and receiving a total of 14 in. of water. It is suggested "that a large amount of water has a tendency to cause too many potatoes to set; more than the vine can support."

The action of atmospheric electricity on the growth of mangel-wurzels, turnips, oats, beans, buckwheat, and potatoes, J. W. SANBORN (*Utah Sta. Rpt. 1893, pp. 71–74*).

Synopsis.—Atmospheric electricity conveyed by a network of wires 10 in. deep in the soil apparently increased to a large extent the yield of mangel-wurzels, potatoes, oats, beans, and buckwheat, but reduced the yield of turnip roots.

On a pole 20 ft. high was attached a wire terminating in a copper brush. This wire was run beneath the ground in checks 3 ft. square and at a depth of 10 in. The plat used was 2 by 4 rods, or one-twentieth acre. Two rows of each of the crops were run across the entire length of the plat, one end of which was wired; the other end was not wired, and as it did not receive the spading made necessary on the other half in laying down the wires, the 2 halves of the plat were not strictly comparable. However, the author states that by the use of tiling spades only narrow trenches were made on the wired portion, and that the soil was a loose, sandy loam. "It is believed that the trenching was of no assistance to the growing crop" on the wired end.

The following tables give the yields:

Influence of atmospheric electricity on root crops.

	Tops per acre.		Roots per acre.		Increase (+) or decrease (—) in roots.
	Wired.	Not wired.	Wired.	Not wired.	
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Per cent.*
Long red mangel-wurzels	6,600	3,840	14,040	10,560	+ 32.5
Do	9,840	4,680	22,320	12,960	+ 72.2
Yellow ovoid mangel-wurzels	4,540	1,960	13,720	6,380	+115.0
Large white turnips	13,780	7,220	15,240	27,560	— 59.0
Do	10,720	8,720	17,540	17,960	— 2.0
Yellow Aberdeen turnips	10,680	6,800	16,340	12,020	+ 36.0
Potatoes			[1] 385	[1] 350	

[1] Bushels.

Influence of atmospheric electricity on oats, beans, and buckwheat.

	Straw per acre.		Grain per acre.		Increase in grain.
	Wired.	Not wired.	Wired.	Not wired.	
	Pounds.	*Pounds.*	*Bushels.*	*Bushels.*	*Per cent.*
Oats	2,989	1,772	46.02	27.21	69.00
Beans	2,790	1,979	19.38	13.74	41.00
Buckwheat	2,692	1,810	27.60	21.31	22.13

On the wired plats the tops or straw of all crops was larger than on the section not wired.

The largest yield of mangel-wurzel roots was obtained on the wired section; the largest yield of turnip roots on the section not wired. The largest yield of grain was obtained in every case on the wired section.

Experiments with wheat, C. C. GEORGESON, F. C. BURTIS, and D. H. OTIS (*Kansas Sta. Bul. 47, pp. 11–16*).—Very cold weather late in March following warm weather in the earlier part of the month and a freeze on May 20 made the wheat crop almost a complete failure on the station farm, and hence the following experiments were abandoned for 1894:

Hot-water treatment for stinking smut, methods of seeding, seeding at different dates, early and late plowing for wheat, influence of the quality of seed wheat on the yield, effects of compacting the seed bed, amount of seed wheat per acre, and effects of pasturing wheat.

The yields made on the plat grown continuously without manure and on the rotation plats are tabulated, but no conclusions are drawn.

"[Of 51 varieties tested in 1894] the Turkey stood the March freeze better than any other variety, it being somewhat tardy in its growth, and, in consequence, it shows the best yield, an average of 8 plats giving a yield of nearly 27½ bu. to the acre. This variety is held in high esteem in many parts of the State, and it may properly be classed with our most productive wheats. . . . Although the Currell suffered badly, we still consider this our best wheat."

Field experiments with wheat, R. L. BENNETT and G. B. IRBY (*Arkansas Sta. Bul. 29, pp. 115–127, fig. 1*).—These experiments were conducted on sandy soil at the Newport Substation. Neither acid phosphate, kainit, nor gypsum used alone increased the yield of wheat. Cowpeas planted July 31 and plowed under October 10 (about 2 weeks before wheat was sowed) increased the yield of wheat over the plat without green manure nearly 12 bu. per acre. A plat upon which cowpea vines without the peas had been turned under in October produced 15 bu. 30½ lbs. of wheat per acre. When the peas were not removed from the vines the yield was 18 bu. 10½ lbs. of wheat per acre. The yield of peas and hulls was 1,160 lbs. per acre, an amount sufficient to pay the cost of picking and the loss of wheat resulting from removing the peas. When the pea vines with immature pods were turned under July 31 the yield was 14 bu. 32 lbs. of wheat.

Deep and shallow preparation of the soil for wheat produced practically no difference in the yield, nor was there any great difference in the yield of wheat produced by the use of native seed or seed from Missouri and Michigan.

The bulletin also contains a brief report on an experiment on the time for planting wheat and brief notes on grain insects.

Time of irrigating fall wheat, A. A. MILLS (*Utah Sta. Rpt. 1893, pp. 214–216*).—Of 5 plats seeded with fall wheat 4 were irrigated, the number of irrigations and the time of irrigation varying. The yields of fall

wheat and of a plat of spring wheat contrasted with it are given in the following table:

Yields of irrigated wheat.

	Yield per acre.		
	1892.	1893.	Average.
Fall wheat:	*Bushels.*	*Bushels.*	*Bushels.*
One irrigation in the fall	8.67	7.11	7.89
No irrigation	9.78	3.00	6.39
One irrigation in spring	9.78	8.45	9.12
Two irrigations in spring	10.88	11.22	11.55
Three irrigations in spring	10.88	11.67	11.28
Spring wheat, three irrigations in spring	11.11	9.00	10.06

"Fall irrigation in 1891, when the rain brought the grain all up, was detrimental to both yield of grain and straw, while in the succeeding fall, when there was not rain enough to bring the grain up till late, the fall irrigation was beneficial, the average being a little in favor of the fall irrigation. The increase over no irrigation is not enough to justify the expense of fall irrigation. It would appear, too, that 2 irrigations in the spring is about the proper amount of water to give fall grain on exceedingly dry ground. . . . It seems that a good fall wheat might save 2 irrigations and give the same returns as our spring wheat is doing."

Experiments with wheat and barley, R. H. MILLER and E. H. BRINKLEY (*Maryland Sta. Bul. 28, pp. 137–149*).—Taking the average results for 1893 and 1894, the following were the most prolific varieties of wheat: Fultz (yielding 44.4 bu. per acre), Garfield, Valley, Wisconsin Triumph, Badger, and Currell Prolific.

The yield of wheat following a crop of cowpeas turned under August 17 was 39.8 bu.; that following crimson clover sown March 30 and plowed under July 19 was 41.3 bu. per acre.

On a plat which had been limed for the preceding crop of corn, wheat yielded at the rate of 31.3 bu. per acre. On a check plat which had not been limed the yield was 22.8 bu. of wheat per acre. Nitrate of soda applied April 14 did not increase the yield of wheat which had been fertilized in the fall, but increased by 7.7 bu. per acre the yield of wheat which had not been fertilized in the fall.

In a comparison of the yields of wheat and barley the yield of wheat was 36.7 bu.; of winter barley, 50.5 bu.; of 2-rowed spring barley, 24.2 bu., and of 6-rowed spring barley, 29.2 bu.

Experiments in rolling and hoeing wheat, J. W. SANBORN (*Utah Sta. Rpt. 1893, pp. 139–150*).—The difference between the yields of wheat on plats rolled and unrolled was slight. Soil temperatures and percentages of moisture in the soils of rolled and unrolled plats are tabulated. "It seemed that the unrolled area had a lower temperature."

Wheat not hoed yielded 15.5 bu. per acre; hoed 1 in. deep, 12.58 bu.; hoed 2 in. deep, 13.44 bu.; hoed 3 in. deep, 9.61 bu.; and hoed 4 in. deep, 9.75 bu. Determinations of soil temperatures and moisture on plats hoed at different depths are tabulated.

Time of harvesting wheat, J. W. SANBORN (*Utah Sta. Rpt. 1893, pp. 164–166*).—The average results for 4 years were as follows: When

wheat was cut in bloom the yield was 0.6 lb. per plat; when in the milk stage, 13.8 lbs.; when in the early dough stage, 49.2 lbs.; when in full dough, 71.72 lbs.; when the grain was dry to the center, 97.5 lbs.; when hard to the center, 85 lbs.; when ripe, 78.7 lbs.; and when overripe, 66.4 lbs. The heavy loss after the time when the grain was dry to the center is attributed in part to injury from wind.

Experiments in plowing, J. W. SANBORN (*Utah Sta. Rpt. 1893, pp. 107–123*).

Synopsis.—These consisted of tests of (1) the width of furrow, the result slightly favoring wide furrows; (2) depth of plowing, in which the differences in crop from different depths of plowing were very slight; and (3) time of plowing, in which the results were inconclusive.

The yield of wheat when the furrows were 16 in. wide was 16.2 bu. per acre; 12 in. wide, 15 bu.; and 8 in. wide, 15.5 bu. The total yields of grain and straw for plats plowed with furrows 16, 12, and 8 in. were, respectively, 2,547 lbs., 2,245 lbs., and 1,981 lbs per acre. The percentages of moisture in plats prepared with different widths of furrow are tabulated. The average percentage of moisture when the furrows were 16 in. wide was 5.85, when 8 in. wide, 5.69.

Plats on which wheat was sown were plowed to depths of 4, 6, 8, and 10 in. or left unplowed. The yields were as follows: Not plowed, 8.21 bu. per acre; plowed 4 in. deep, 13.5 bu.; plowed 6 in. deep, 13.30 bu.; plowed 8 in. deep, 14.30 bu., and plowed 10 in. deep, 13 bu.

The temperature of the soil and moisture content at depths of 4, 6, 8, 10, and 12 in. are tabulated. "The temperature does not appear to be materially varied until we reach a depth of 10 in. The fluctuations in temperature when taken at various depths seemed to reveal no broad law. It would appear, however, by the table that very deep cultivation tends to increase the temperature of the soil." The differences in percentages of moisture on the several plats were slight.

Plowing at different dates in fall and spring gave inconclusive results. The temperature and moisture content of the plats prepared at different dates are tabulated.

Methods of harrowing for small grain, J. W. SANBORN (*Utah Sta. Rpt. 1893, pp. 123–129*).—The yields of barley, oats, and wheat on plats either not plowed but harrowed, or after plowing cultivated with different degrees of thoroughness and with different harrows are tabulated.

"No harrowing at all proved equal to excessive harrowing, while plowing and merely dragging the soil level resulted as favorably as not harrowing. The square-toothed harrow gave results slightly above the average. . . . Where there was excessive harrowing there was the largest ratio of straw to grain." The soil was a sandy loam. Soil temperatures and the percentages of moisture for the different plats are tabulated. The variations in the temperature on different plats were slight. "Excessive harrowing seems to have depressed the amount of water."

Preservation of crops, J. W. SANBORN (*Utah Sta. Rpt. 1893, pp. 32–37*).—The experiments which are detailed in preserving corn fodder, clover hay, wheat, and timothy hay, gave the following results:

"(1) Unweighted silage met with a loss of 29.28 per cent.

"(2) Weighted silage met with a loss of 7.28 per cent, a smaller loss than is usually reported.

"(3) Corn fodder in the loft met with a loss of 21.35 per cent, a greater loss than is commonly reported.

"(4) Clover hay, whether stacked out doors, housed in the barn, or suspended in small lots in bags, showed no loss either from fermentation or from oxidation.

"(5) Wheat gained in total weight by winter storage.

"(6) Timothy hay showed no loss save that housed in the barn, and this loss probably may be traced in part to faulty sampling or faulty analysis, and amounts to about 10 per cent."

Rotation of crops, J. W. SANBORN (*Utah Sta. Rpt. 1893, pp. 74–85*).—The data obtained during 4 years in experiments with a 2-years' rotation, a 4-years' rotation, and a 6-years' rotation are recorded as a report of progress, and portions of this data, together with the theory of rotation, are discussed. The crops grown were wheat, clover, potatoes, barley, and timothy. On check plats these crops were grown continuously. Generally rotation increased the yield, but sufficient time has not yet elapsed to permit of definite conclusions regarding the amount of increase due to rotation and the relative advantages of the several rotations.

On certain plats of the 6-years' rotation series the percentages of moisture in the soil and the temperatures at different depths were determined and the results tabulated. On the plat on which wheat was grown the soil temperature at a depth of 3 in. was considerably higher than at the same depth on the plat growing clover and timothy.

Twenty-five years of plant breeding, RIMPAU (*Deut. landw. Presse, 21 (1894), No. 98, p. 11*).

Report on culture experiments with barley in Schleswig-Holstein in 1892, A. EMMERLING and H. GÖTTSCH (*Landw. Wochenbl. Schles. Holst., 43 (1894), No. 50, pp. 707–709*).

Variety test of barley, A. A. MILLS (*Utah Sta. Rpt. 1893, pp. 228–232*).—The yields obtained in 1890, 1891, 1892, and 1893 are tabulated. The variety Lump Blue gave the largest average yield (25.57 bu. per acre) and the largest single yield.

Green manuring for barley, J. W. SANBORN (*Utah Sta. Rpt. 1893, pp. 173–175*).—A crop of peas plowed under in 1893 increased the crop of barley in 1893 from 7.22 bu. per acre to 22.56 bu. Wheat used as green manure failed to increase the yield of the following crop.

A machine for harvesting beets (*Deut. landw. Presse, 21 (1894), No. 95, p. 886, fig. 1*).

Practical canaigre culture, C. B. ALLIARE (*Irrigation Age, 7 (1894), No. 5, p. 226*).—The need of extending the market is pointed out, the dry roots being only $40 per ton in Hamburg and Liverpool. Canaigre is claimed to be an excellent substitute for gambier and other high-grade tanning materials. It is easily grown and does not require more than 6 inches of water. As far as known it has no insect enemies.

Composition and fertilizer requirements of cereals, H. JOULIE (*Monit. Scient., 8, pp. 641–654; 8, II, pp. 731–740; abs. in Chem. Centbl., 1894, II, No. 19, p. 802*).—

Methods of field experimentation and of analysis are discussed. The author's analysis of wheat plants confirmed previous results in showing a centesimal and absolute loss of potash between the blooming and ripe stages.

Cost of potash for corn, W. F. MASSEY (*Cult. and Country Gent., 1894, Nov. 29, p. 855*).—A brief popular summary of trials at a number of stations of different forms of potash, etc.

Cotton crosses and hybrids, R. J. REDDING (*Georgia Sta. Bul. 24, pp. 124–126*).—A general discussion of the methods of improving cotton by selection and crossing, with a list of 19 crosses made at the station.

Experiments with forage crops, J. G. LEE (*Louisiana Stas. Bul. 29, 2d ser., pp. 1040–1047*).—The yields of forage produced by pearl millet, Jerusalem corn, yellow millo maize, white millo maize, large African millet, Kaffir corn, German millet, French millet (red), soja bean, wild rice, upland rice, Japanese rice, and 6 varieties of saccharine sorghum are tabulated and brief notes on each are given. Large African millet gave the largest yield of forage and also the largest yield of grain, 28.5 bu. per acre. There are brief notes on 13 varieties of cowpeas and on red clover, crimson clover, alfalfa, white clover, melilotus, alsike clover, Texas blue grass, rescue grass, Italian rye grass, English rye grass, tall meadow oat grass, redtop, Kentucky blue grass, orchard grass, and velvet grass. Spanish peanuts were grown.

Sorghum and other forage crops, A. A. MILLS (*Utah Sta. Rpt. 1893, pp. 233, 234*).—Brief mention is made of the character of growth of the following plants: White lupines, pearl millet, white durra, spring vetch, teosinte, *Lathryus sylvestris*, Jerusalem corn, Kaffir corn, yellow millo maize, rape, and several varieties of millet and saccharine sorghum. *Lathyrus sylvestris* dried up during the summer of 1893, though it remained green several weeks after the alfalfa plants growing with it were dried.

Lathyrus sylvestris culture, K. HANSEN (*Landmandsblade, 27 (1894), pp. 611–616*).

A variety test of oats, A. A. MILLS (*Utah Sta. Rpt. 1893, pp. 216–224*).—Yields of all varieties grown in 1890, 1891, 1892, and 1893 are tabulated. Of those grown for 4 years, Prince Edward Island gave the largest yield, followed by Wide Awake and American Banner.

Fertilizer experiments with oats and barley, J. G. LEE (*Louisiana Stas. Bul. 29, 2d ser., pp. 1044, 1045*).—Two hundred pounds of cotton-seed meal and 100 lbs. of superphosphate per acre applied at time of planting largely increased the yield of oats and barley.

Fertilizer experiments on barley, oats, and wheat, J. W. SANBORN (*Utah Sta. Rpt. 1893, pp. 65–69*).—Fertilizer experiments were conducted on barley, oats, and wheat on poor gravelly soil, not uniform in fertility, and the results are tabulated. "So far as I understand the results, a small amount of nitrogen has proved as efficient as a larger quantity. Both potash and nitrate of soda have increased the crop. . . . Nitrate of soda and potash used together appear to be quite as effective as yard manure."

Time of sowing oats, J. W. SANBORN (*Utah Sta. Rpt. 1893, pp. 165, 166*).—Early seeding gave larger yields than late seeding.

The culture of oats, BESELER (*Magd. Ztg., 1894, No. 211; abs. in Centbl. agr. Chem., 22 (1894), No. 11, pp. 757–759*).

Potatoes by irrigation, J. W. GREGORY (*Irrigation Age, 7 (1894), No. 5, p. 229*).—Gives results of experience at Greeley, Colorado, as to amount and frequency of irrigation. As improved methods of cultivation and manuring are practiced more water appears to be needed.

Soaking seed potatoes (*Agl. Gaz. N. S. W., 5 (1894), No. 10, pp. 725–727*).—Effect of different solutions of fertilizers on germination.

The culture of Polygonum sachalinense (*Prog. Agr. et Vit., 11 (1894), No. 51, pp. 655–658*).

Ramie, its culture and preparation (*Abs. in Agl. Gaz. N. S. W., 5 (1894), No. 10, pp. 693–697*).—Popular.

A variety test of rye, N. WESTERMEIER (*Deut. landw. Presse, 21 (1894), No. 100, pp. 959, 960*).

Sugar beets, E. FULMER (*Washington Sta. Bul. 9, p. 16*).—This is a popular discussion of the subject, in which the author treats of the history of sugar-beet culture in Europe and in the United States, and raises the question of the advisability of growing sugar beets in Washington.

The sugar beet in South Dakota, J. H. SHEPARD (*South Dakota Sta. Rpt. 1892, p. 68*).—A reprint of Bulletin 27 of the station (E. S. R., 3, p. 889).

Field experiments with sugar cane, J. R. BOVELL and J. P. D'ALBUQUERQUE (*Rpt. Exptl. Fields, Dodds Reformatory, Barbados, 1893, pp. 1–44*).—Experiments with fertilizers, varieties, and planting different portions of the stalk.

Analysis of turnips, J. VAN DEN BERGHE (*Lab. Agr. Prov. Roulers, West Flanders, Rpt. 1893, pp. 14–16*).—Analyses of 12 varieties gave the following results: Water, 91.65 per cent; crude protein, 1.68; true albuminoids, 1.22; sugar, 2.8, and starch, 0.46.

Experiments in sowing wheat, J. W. SANBORN (*Utah Sta. Rpt. 1893, pp. 166–173*).—The average results for 4 years favored sowing spring wheat at a medium date rather than early or late, and showed very slight differences between drilling and broadcasting. Experiments with large and small seed and with heavy seed and that of ordinary wheat gave results considered unsatisfactory by the experimenter. The yields obtained for 4 years by sowing from 2 to 10 pecks of seed wheat per acre are tabulated. The results are not conclusive.

Researches on the color and nitrogen content of wheat grains of different varieties differently fertilized, G. CANOVA (*Staz. Sper. Agr. Ital., 27 (1894), No. 3, pp. 261–276*).

Experiments with varieties of wheat, A. A. MILLS (*Utah Sta. Rpt. 1893, pp. 201–213*).—Tabulated data for all varieties grown in 1890, 1891, 1892, and 1893 are given. The soil was uneven in fertility, and it was thought necessary to make corrections in the yield. "Of 23 varieties, grown 3 years or more, Gypsum leads in yield, while Northcote Amber, Beryl, Australian Club, Lofthouse, Standard, Ruby, and Granite followed in the order named."

A system for the classification of varieties of wheat, with a résumé of similar work by earlier investigators, J. ERIKSSON (*Landw. Vers. Stat., 45, pp. 37–135; abs. in Ann. Agron., 20 (1894), No. 11, pp. 534–556*).

Wheat culture in Modena, G. CANOVA (*Staz. Sper. Agr. Ital., 27 (1894), No. 3, pp. 277–301*).—This paper is largely occupied with a discussion of rotation and of the cost of growing wheat.

Fertilizer experiments on a rotation of crops, J. G. LEE (*Louisiana Stas. Bul. 29, 2d ser., pp. 1015–1017*).—The results of a three-course rotation consisting of corn, oats and cowpeas, and cotton on fertilized and unfertilized land are tabulated for the 5 years, 1889–93. Fertilizers largely increased the yield of every crop.

Report on culture experiments with various crops in Norway in 1893, B. LARSEN (*Tidskr. norske Landbr., 1 (1894,) pp. 375–387*).—Tests of varieties of barley, oats, clover, and timothy conducted at a number of substations since 1889.

The preservation of green fodder, A. NEEB (*Orgaan Ver. Oudleerlingen Rijks Landbouwschool, 7 (1894), No. 76, pp. 54–60*).—A review of the history of ensiling in Netherlands, with a full account of methods, construction and capacity of silos, cost, and a table of analyses of silage.

HORTICULTURE.

Electricity and plant growing, L. H. BAILEY (*Trans. Mass. Hort. Soc. 1894, pt. 1, pp. 54–79*).—The application of electrical illumination and of electricity to plant growing and the effect of atmospheric elec-

tricity upon vegetation are discussed at some length. It is argued that normal atmospheric electricity is in some way beneficial to vegetation. Lemström's experiments in Finnish Lapland and Spitzbergen in 1885, and in Finland in 1886-'87, are quoted as proving that atmospheric electricity applied artificially may exert a powerful influence upon growing plants, the character of the influence varying with the species. Some experiments in France in 1888 upon strawberries are brought forward as showing that the simultaneous action of electricity and high temperature is injurious to plants.—A. McADIE.

Field experiments with sweet potatoes, F. H. BURNETTE (*Louisiana Stas. Bul. 30, 2d ser., pp. 1052-1089*).

Synopsis.—These consisted of distance experiments in which the crop was largest when the plants stood 18 in. apart in 3½ ft. rows; tests of best height of rows, resulting in favor of ridges 16 in. high; experiments in moving and pruning the growing vines, by both of which operations the yield was reduced; tests of cuttings from different parts of the vines and of different lengths, resulting in favor of cuttings from the terminal end of the vine and 24 in. in length; and variety tests. The yields and descriptions of 36 varieties tested are given. The largest yield, 1,057.8 bu. per acre, was produced by the variety Providence.

Distance experiments (p. 1057).—The average yields for 3 years of sweet potatoes grown at different distances in rows 3½ ft. apart were as follows:

Average yield per acre of sweet potatoes grown at different distances.

Distance in the row.	Yield per acre.	
	Merchantable.	Culls.
	Bushels.	*Bushels.*
8 in	252.07	13.36
12 in	258.31	11.01
15 in	275.01	10.48
18 in	281.82	11.71
24 in. (1893)	249.08	15.96

Height of ridges (pp. 1057, 1058).—The average yields for 20 years of sweet potatoes grown on ridges of different heights were as follows:

Average yield per acre of sweet potatoes grown on ridges of different heights.

Height of ridges.	Yield.	
	Merchantable.	Culls.
	Bushels.	*Bushels.*
On the level	130.03	33.57
4 in	219.84	22.53
8 in	197.07	17.33
12 in	221.59	16.45
16 in	261.18	25.45

Moving and pruning sweet-potato vines (pp. 1058, 1059).—Vines left undisturbed yielded 335.9 bu. of sweet potatoes per acre; lifted twice per week, 314.5 bu., and pinched repeatedly to a length of 2 ft., 273.7 bu.

Length and source of vine cuttings (p. 1059).—The following table gives the average results for 2 years in using vine cuttings of different lengths and from different parts of the vine. Sets directly from the beds were also grown for comparison.

Yield produced by vine cuttings of different lengths and from different parts of the vine.

Treatment.	Yield per acre.		
	Merchantable.	Culls.	Total.
	Bushels.	*Bushels.*	*Bushels.*
Cuttings 6 in. long	210.92	24.71	235.63
Cuttings 12 in. long	201.96	33.48	235.44
Cuttings 18 in. long	277.45	23.22	300.67
Cuttings 24 in. long	315.31	21.78	337.09
Whole vines exposed every 15 in	300.24	23.22	323.46
Whole vines covered all but leaves	190.09	16.28	206.37
Terminal end of vine	340.46	22.48	362.94
Middle portion of vine	329.97	15.89	345.86
Butt end of vine	261.63	21.48	286.11
"Slips"	352.60	33.10	385.70

Varieties (pp. 1053–1056).—The yields of the most productive varieties were as follows in bushels of marketable roots per acre: Providence, 1,057.8; Shanghai, 741; Red Nansemond, 696.6; Peabody, 684; Hayman, 638.8, and Norton, 638. A late crop of each variety was also grown, transplanting occurring August 15. With the late crop the largest yield was made by Red Nansemond—228 bu. per acre, of which 75 per cent was marketable. Following this variety in yield of marketable potatoes were Padisha, Providence, Strasburg, and Early Golden.

The bulletin also contains brief statements, but no detailed results, of fertilizer experiments, and notes on soft rot and black rot. Soft rot was checked by dusting the roots with fostite.

The vanilla bean in Mexico, C. SCHAEFER (*U. S. Consular Rpt. 1894, Nov., pp. 395, 396*).—Notes on the culture, curing, and marketing of the fruit of this orchid. Vanilla beans are grown chiefly in the canton of Papantla, where they also grow wild on the rich, loamy soil of the low hills. The vines are planted in a plantation of small, low trees, about three slips being set at the base of each tree, up which they climb, and are conducted by poles from tree to tree. The vines bear full crops in the third year, and live about 10 years. The beans are gathered from October to January, and after being subjected to a heat of 120° F. for 24 hours, in ovens, are placed in blankets and the blankets exposed to the sun until the beans are entirely dry. They are sent to market in bundles of 50, wrapped in tin foil, inclosed in tin cylinders, and bring about $3.50 per pound.

Impressions of the peach industry in western New York, L. H. BAILEY (*New York Cornell Sta. Bul. 74, pp. 361–386, pl. 1, figs. 12*).—This bulletin is in two sections, the first consisting of general remarks on the care of peach orchards, and the second on their enemies and diseases.

The unsatisfactory state of the peach industry in New York is believed to be due to careless and unscientific methods, such as lack of cultivation, inattention to insects and diseases, neglect to thin the fruit, and carelessness and untidiness in marketing. Warm, deep, sandy lands are considered ideal peach soils, but high shaly or gravelly soils in the lake regions, well drained and so situated as to escape the late spring frosts, are well adapted to produce good crops. Very frequent shallow cultivation of the soil is advised from May until August, when occasionally a green crop, as vetch or crimson clover, can be sown, to be plowed under the next spring. The peach orchard should never be sowed to grain. The trees should be planted about 20 feet apart. In addition to the tillage and green manure crop, fertilizing with ashes, muriate of potash, and bone fertilizers is urged.

The vase-form method of pruning is advocated, the trunks being short and the top allowed to spread at will. Care should be taken that the branches do not start from the trunk at exactly the same height, thus avoiding the liability of splitting. If the tops are headed they become thicker and shut off much of the sun from the ripening fruit. The fruit should be thinned after the "June drop," when the peaches are the size of the end of one's thumb, and no 2 peaches should stand closer together than 5 in.

In marketing the peaches care should be taken in packing them, so that they may present an attractive appearance to the purchaser. Out of 47 varieties of peaches recommended in lists obtained from 17 growers in the State the following varieties are preferred by 5 or more: Early and Late Crawford, Oldmixon Free, Foster, Elberta, Early Rivers, Brigdon, Mountain Rose, Salway, and Wheatland.

Notes are given on the peach-tree borer, fruit-bark beetle, or pin-hole borer (*Scolytus rugulosus*), curculio, black peach aphis, fruit rot and twig blight (*Monilia fructigena*), mildew (*Podosphæra oxyacanthæ*), black spot (*Cladosporium carpophilum*), leaf curl, and root galls. Illustrated descriptions are given and remedies detailed.

A map is also given showing the chief peach orchard areas in the Niagara-Ontario district.

The cultivation of orchards, L. H. BAILEY (*New York Cornell Sta. Bul. 72, pp. 297–314, pl. 1*).—General suggestions on the subject of orchard tillage. It is urged that the soil and location be adapted to the particular fruit it is desired to grow, and that if perfect natural drainage does not exist tile drainage should be employed. The land should be plowed deeply in the spring, followed by frequent shallow cultivation. Fall plowing is discouraged, as it leaves the soil in a loose condition, through which, in winter, the roots may be injured. For the first 2 years only hoed crops, if any, should be grown in the orchard, a space several feet in extent being left about each tree. Barnyard manure and other fertilizers rich in nitrogen should be cautiously applied, for they are liable to produce luxuriant foliage at the expense

of the fruit. Potash, either in the form of wood ashes or muriate of potash, is the most important element, though phosphoric acid may also be applied by means of bone fertilizers. The necessary nitrogen can easily be obtained by means of tillage and green crops, of which vetch, field peas, and crimson clover are especially recommended.

A new method of budding, R. H. PRICE (*Texas Sta. Rpt. 1893, p. 414*).—A brief note on a method of budding trees and cuttings during the winter, when the sap is dormant. A slice of bark was cut down the stock and left attached at the lower end. Part of the top of the loose slip was then cut off and the bud fitted over the cut place and bound firmly on with a piece of raffia. The stocks were kept in sphagnum moss until spring, when all but one of the 50 young peach trees used in the experiment were found to have firmly "knit," and made strong shoots in the growing season.

Hardy grapes, J. FISHER (*Trans. Mass. Hort. Soc. 1894, pt. 1, pp. 39–52*).—An account of 40 years of experience in grape growing, with recommendations in regard to the cultivation of the vine and remarks on the hardiness of various varieties. A somewhat clayey, sloping ground is recommended, the vines to be pruned by the renewal system, trained on trellises, fertilized with barnyard manure and a special formula of commercial fertilizers, consisting of sulphate of potash, 225 lbs.; sulphate of ammonia, 100 lbs.; nitrate of soda, 200 lbs.; South Carolina floats, 200 lbs.; sulphate of magnesia, 50 lbs., and plaster, 75 lbs. per acre. The Concord grape is regarded as the hardiest and most valuable variety to be grown. A discussion of the paper follows, bringing out various points in regard to pruning and marketing.

Nut culture for North Carolina, W. A. TAYLOR (*North Carolina Sta. Bul. 105, pp. 273–276*).—An article reprinted from the Thirteenth Annual Report of the North Carolina Horticultural Society. Brief notes on the varieties of nuts best adapted for cultivation in the State. The black walnut, butternut, mockernut, and shellbark hickory are considered not worth planting for their nuts; but European and Japanese chestnuts, pecans, and Persian or English walnuts (*Juglans regia*) are recommended. Of chestnuts, Paragon, Ridgely, Numbo, Giant, Early Prolific, and Superb are advised; of pecans, Faust, Frotscher, Jewett, Ribera, Stuart, Turkey Egg, and Van Deman; of walnuts, Chaberte, Franquette, Mayette, and Præparturiens. It is thought that probably a Japanese walnut (*Juglans sieboldiana*) may be found suitable.

Flowering bulbs in North Carolina and their propagation for florists' use, W. F. MASSEY (*North Carolina Sta. Bul. 107, pp. 323–344, figs. 22*).—General remarks on the growing of flowering bulbs and the open field for their cultivation in the State. Cultural directions are given for the amaryllis, freesia, *Hyacinthus candicans*, gladiolus, Roman hyacinth, *Richardia ethiopica*, *Lilium candidum*, *L. longiflorum*, narcissus, tuberose, and tulip. As an appendix is quoted an article by C. L. Allen,[1] advocating the cultivation of Roman hyacinths in North Caro-

[1] New York Florists' Exchange, August, 1894.

lina. The figures are natural-sized illustrations of the bulbs of several varieties of narcissus, lilies, and tulips.

Curl-leaf cabbages, S. MOTTET (*Rev. Hort., 66 (1894), No. 20, pp. 473–475, figs. 3*).—Brief notes on the curl or frizzle-leafed cabbages and their use as ornamental vegetables for table purposes.

A variety test of chicory, O. PITSCH (*Deut. landw. Presse, 21 (1894), No. 99, p. 951*).

Chicory in Belgium, H. C. MORRIS (*U. S. Consular Rpt. 1894, Oct., pp. 157, 158*).—Note on the extent of its cultivation and statistics of the crop. The Belgian product is considered superior to that of France or Germany, and in many parts of Europe is mixed with coffee or used instead of it. From 280,000 to 350,000 tons of fresh roots are produced yearly, yielding 70,000 to 80,000 tons of dried roots. About two-thirds of this is exported, France taking about 25,000 tons and Germany about 10,000. In 1893 the United States received about 4,000 tons, valued at nearly $130,000. Of late the fresh roots are beginning to be imported to the United States and manufactured here.

Gourds, S. MOTTET (*Rev. Hort., 66 (1894), No. 18, pp. 428–430, pl. 1, figs. 3*).—Descriptive and cultural notes on gourds, 10 varieties of which are illustrated in colors.

A talk about mushrooms, W. FALCONER (*Trans. Mass. Hort. Soc. 1894, pt. 1, pp. 98–123*).—A popular paper on edible mushrooms and the methods of growing them in greenhouses, stables, cellars, quarries, and caves. A new species, *Agaricus subrufescens*, is believed to be very productive and desirable. In the subsequent discussion various points on growing and cooking mushrooms were brought out and are given. Numerous receipts for cooking mushrooms are appended.

Planting radish seed, G. ALLUARD (*Rev. Hort., 66 (1894), No. 19, pp. 455–457, figs. 6*).—Notes on experiments with planting radish seed deep or shallow, with figures of the resulting vegetables. It is recommended that the ground be well loosened and the seed planted about 1 in. deep.

Influence of soil on the quality of vegetables, G. ALLUARD (*Rev. Hort., 66 (1894), No. 20, pp. 472, 473*).—Brief popular notes on the effect produced by various soils on the flavor and odor of various economic plants, especially those used as relishes or condiments.

Vegetable tests, E. S. RICHMAN (*Utah Sta. Rpt. 1893, pp. 190–197*).—Notes and tabulated data on 17 varieties of sweet corn, 13 of garden peas, 16 of bush beans, 4 of Lima beans, 2 of field beans, 52 of cabbage, 8 of radishes, and 16 of squashes, with recommendations of preferred varieties.

Vegetables under glass, W. D. PHILBRICK (*Trans. Mass. Hort. Soc. 1894, pt. 1, pp. 186–195*).—A popular discussion of the methods of hotbed and greenhouse forcing of vegetables, with details of the construction, manuring, and heating.

Growing seeds for the market, J. J. H. GREGORY (*Trans. Mass. Hort. Soc., 1894, pt. 1, pp. 174–185*).—A popular paper on the commercial raising of vegetable and flower seeds on a large scale, mentioning the manuring, cultivating, gathering, drying, and cleaning the seeds, with special remarks on various vegetables.

The construction of plant houses, W. A. BURNHAM (*Trans. Mass. Hort. Soc. 1894, pt. 1, pp. 79–97*).—A discussion of several styles of greenhouses, with remarks on plans, location, ventilation, and the desirability of sash bar, wood frame, or iron frame buildings. Technical directions are given for the construction of the building, the plant beds, and the heating system.

The species of Phœnix cultivated at Nice, SAUVAIGO (*Rev. Hort., 66 (1894), No. 21, pp. 493–499, figs. 3*).—Botanical, descriptive, and popular notes on the date palms of this genus, with special remarks on *Phœnix melanocarpa*, which has been successfully fruited at Nice.

Peach culture in Belgium, H. C. FYFE (*Gard. Chron., 16 (1894), ser. 3, p. 691*).

Pruning, E. HOYT (*Trans. Mass. Hort. Soc. 1894, pt. 1, pp. 28–39*).—A popular paper on the advantages of pruning fruit trees, with detailed directions for its practice on various orchard fruits, grapevines, raspberries, rosebushes, and shade trees. Additional points were brought out and enlarged upon in the ensuing discussion, particularly in regard to fertilizing and cultivating orchards and combating fungus and insect enemies, and methods and times of planting and grafting.

Peach pruning, A. DELAVILLE (*Rev. Hort., 66 (1894), No. 22, pp. 529, 530, figs. 2*).—Recommendations for pruning the fruit twigs of peach trees in the autumn, so as to induce a sufficient growth of leaves to nourish the fruit.

Pruning supports, A. CHARGUERAUD (*Rev. Hort., 66 (1894), No. 22, pp. 518–521, figs. 8*).—Illustrated and descriptive notes on contrivances of ropes and girdles for the safety of those engaged in pruning the tops of trees, with directions for their use.

Strawberry, sand cherry, and orchard notes, C. A. KEFFER (*South Dakota Sta. Rpt. 1892, pp. 18*).—A reprint of Bulletin 26 of the station (E. S. R., 3, p. 537).

American fruit in England, C. MEEKER (*U. S. Consular Rpt. 1894, Nov., pp. 399–402*).—Remarks on the shipping of fruit from America to England, its usual over-ripe condition on arrival, and the prevailing prices. It is thought that American fruit can find a good market in England if gathered before complete maturity and properly packed and shipped in cold storage.

The preservation of garden fruits, G. BELLAIR (*Rev. Hort., 66 (1894), No. 20, pp. 482, 483*).—A few popular suggestions on the keeping of fruit, low temperatures being most advised.

Best conditions for keeping fresh fruit and methods of packing fruit and vegetables for the English markets, V. MALCORPS (*Rev. Agron. Louvain, 3 (1894), No. 2, pp. 65–91*).

Potash and bone in the orchard, J. H. DEMISE (*Cult. and Country Gent., 1894, Nov. 29, p. 859*).—A farmer's experience in the use of these fertilizers.

The use of gypsum as a fertilizer for the vine, G. BATLANCHON (*Jour. Agr. Prat., 58 (1894), No. 49, pp. 825–829*).

The hardy Catalpa in the West, C. A. KEFFER (*Garden and Forest, 7 (1894), p. 512*).

Shrubs in cold greenhouses and in orangeries, G. BELLAIR (*Rev. Hort., 66 (1894), No. 18, pp. 421–423*).—Cultural notes and directions, for both summer and winter, together with an annotated table of a number of species.

Cinerarias and calceolarias, K. FINLAYSON (*Trans. Mass. Hort. Soc. 1894, pt. 1, pp. 123–132*).—Notes on the propagation, soil, and stimulants to be given cinerarias and calceolarias, with various details of their cultivation and protection against fungus and insect enemies. Both kinds of plants require cool, shady localities and richly manured loam. Some experiments with pruning and selecting plants are cited.

Chrysanthemums, propagation and culture, G. GROSDEMANGE (*Rev. Hort., 66 (1894), No. 19, pp. 448–450*).—General and popular notes, giving directions for growing from seeds, shoots, cuttings, and grafts.

Chrysanthemum culture, G. GROSDEMANGE (*Rev. Hort., 66 (1894), No. 22, pp. 530–534*).—Notes and directions for the culture of chrysanthemums in beds and in pots and for inducing large blossoms, together with lists of varieties to be employed in each case.

Chænomeles japonica serotina, E. ANDRÉ (*Rev. Hort., 66 (1894), No. 18, pp. 423–425, figs. 2*).—Illustrative descriptive notes on the flowers and fruit of this quince, which is considered ornamental, as well as useful for its fruit.

Double petunias, S. MOTTET (*Rev. Hort., 66 (1894), No. 18, pp. 433, 434, figs. 3*).—Descriptive notes on several varieties.

FORESTRY.

The manurial requirements of young pine trees, one and two years old, W. SCHMITZ-DUMONT (*Tharand. Forst. Jahrb., 44, II; abs. in Chem. Centbl., 1894, II, No. 21, p. 875*).

Germinating nuts and acorns, J. G. JACK (*Garden and Forest, 8 (1895), pp. 6, 7*).—Many nuts and acorns quickly lose their vitality when dried, and should either be planted soon after maturing, or preserved in moist but not wet sand, soil, or moss, and kept in a cool place.

The bamboo garden, A. B. FREEMAN-MITFORD (*Garden, 46 (1894), pp. 500–502*).

Geographical distribution of deciduous trees, GRAUER(*Forstw. Centbl., 16 (1894), No. 12, pp. 569–599*).

Text-book of the diseases of trees, R. HARTIG (*Revised ed. London: McMillan & Co., 1894*).

Report on forestry, C. A. KEFFER (*South Dakota Sta. Rpt. 1892, pp. 26*).—Reprinted from Bulletin 29 of the station (E. S. R., 4, p. 44).

SEEDS—WEEDS.

Report of the Seed-Control Station in Christiania, 1892–'93, B. LARSEN (*Tidskr. norske Landbr., 1 (1894), pp. 239–249*).—The station, which was established in 1886, made in all 290 examinations of different kinds of seeds during 1892–'93. The report contains a detailed statement of the results of the examinations made during the year, and also a summary of the results for all samples examined during the years 1887–'93. Below are given the average results obtained for some of the more important seeds examined:

Results of examination of seeds, 1887–'93.

Kind of seed.	Number of samples.	Germinating period.	Percentage germination.	Pure seed.	Impurities.	Foreign seeds.	Weed seeds.	Weight per 1,000 seeds.
		Days.		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Grams.*
Timothy, all varieties	156	13	86.0	95.22	1.32	2.40	1.08	0.439
Orchard grass	7	22	61.4	90.17	6.01	3.80	.02	.905
Sheep's fescue (*Festuca elatior*)	10	18	71.6	96.00	1.79	2.08	.13	1.710
Rye, all varieties	18	9	89.6	97.56	2.21	.09	.14	26.800
Spring wheat	12	14	90.9	98.40	1.42	.18	.01	31.700
Plume oats (*Avena orientalis nigra*)	35	14	89.3	95.92	.70	3.27	.11	34.700
Oats, all varieties	172	17	89.8	97.13	.73	2.11	.04	37.000
Barley (*Hordeum vulgare*), all varieties	74	10	95.0	98.80	.85	.32	.03	39.900
Chevalier barley (*Hordeum distichum*)	11	18	85.7	99.17	.60	.19	.03	44.300
Fan barley (*Hordeum erectum*)	44	13	89.6	97.35	.87	1.76	.20	55.300
White clover	4	13	81.6	96.16	1.88	1.19	.77	.617
Alsike clover, all varieties	73	15	72.0	91.66	2.15	5.69	.49	.675
Red clover, all varieties	179	14	83.6	94.18	3.97	1.43	.41	1.750
Vetch (*Vicia sativa*)	26	11	93.9	97.89	1.77	.32	.03	53.200
Gray pea (*Pisum arvense*)	7	13	85.3	90.73	9.21	.06	......	106.000

—F. W. WOLL.

On the determination of the germinating power of seeds, A. F. HOLLEMAN (*Landbouw. Tijdschr., 1894, No. 5; abs. in Jour. Assoc. Anc. Élèv. Inst. Gembloux, 5 (1894), No. 4, pp. 170, 171*).—The author thinks, in estimating the germinating power of seeds, at least 5 per cent should be allowed for variation. In order to make this allowance the number

of seeds required in the sample should be increased from 300 to 400. Where the germinative ability is less than 75 per cent at least 600 seeds should be tested. As the germinative power approaches 75 per cent the number of seeds tested should be from 800 to 1,000. Where there is no indication as to the relative value of seeds, a sample of at least 400 seeds should be tested, and after the preliminary test is made an increased number, as indicated above.

The Russian thistle, J. WILSON, L. H. PAMMEL, G. E. PATRICK, and J. L. BUDD (*Iowa Sta. Bul. 26, pp. 33, pls. 9*).—The last general assembly of the State of Iowa passed a Russian-thistle law, providing that a bulletin should be prepared by the State Agricultural College on the Russian thistle and means for effecting its extermination. Upon the passage of this act steps were taken to follow its requirements. Seed was procured and grown on the college grounds, in rod-square plats, alone, with timothy and with red clover, on various soils. On plat 1 the seed was planted 3 in. apart in rows. But few plants grew, and these made the largest plants grown on any of the plats. On plat No. 2 the seed was planted the same as on the previous one. Red clover was raked in over this plat, but the season was so dry that it did not grow. The thistle came up thinly and grew vigorously. Plat No. 3 was drier land than the others. It was planted as the other two and timothy seed raked in. The thistles made a thin stand and grew well, but the timothy seed, owing to the drought, did not make any growth. The fourth plat was sown thickly with seed, which came up thickly, and made a growth of from 12 to 20 in. high.

When the thistle first comes up it is soft and velvety to the touch. Sheep and cattle eat it in its young stage, but horses and hogs refuse to touch it. The plants are of very rapid growth, and become prickly so soon that it gives a very short grazing period, not longer than 6 weeks or at most 2 months.

With regard to the remedies, it is easily killed. When cut off at the surface of the ground before seeding it dies. When the plants are not more than 6 in. in height, careful plowing with a drag chain and harrowing to fill up crevices between the furrows will kill every plant that can not get its leaves to the surface. Waste places and the edges of fields must be looked after carefully, as these seem to be favored localities for its growth. Attention must be given to the weeds before they assume the tumbleweed shape, as they then can scatter their seeds very widely.

The botany of the Russian thistle (pp. 8–25).—Various authors are quoted as to the origin and distribution in the United States of the Russian thistle (*Salsola kali tragus*). Other plants are frequently mistaken for the Russian thistle, and on this account the author has given illustrations and descriptions of the spiny nightshade (*Solanum rostratum*), horse nettle (*S. carolinense*), prickly lettuce (*Lactuca scariola*), and lance-leaved thistle (*Cnicus lanceolatus*), and descriptions of *Ama-*

rantus albus and *Cycloloma atriplicifolia*. The anatomy of root, stem, leaf, and seed is given in considerable detail.

The author made some experiments on the vitality of the seed. The seed was subjected to various temperatures for different lengths of time, and it was found that it could stand considerable dry heat, a temperature of between 71 and 78° C. destroying its vitality.

It has been recommended that infested stubble and fields be burned over to destroy the weed, and some preliminary experiments were made along this line in the laboratory. The dried calyx and attached parts burned slowly, but a small amount of fire caused them to crack and throw the embryo out. Out of 68 cases, all seed so treated failed to germinate.

A short bibliography is given of papers on the Russian thistle.

Report of the chemist (pp. 26–29).—Analyses were made of plants in 3 stages of growth, the dry matter of which is summarized in the following table:

Composition of dry matter of Russian thistle cut at 3 different dates.

	Cut June 12.	Cut June 26.	Cut July 12.
	Per cent.	*Per cent.*	*Per cent.*
Crude ash	22.01	18.79	14.30
Ether extract (crude fat)	2.20	1.84	1.14
Nitrogen-free extract (soluble carbohydrates)	39.39	38.46	44.63
Crude fiber	17.94	23.19	30.82
Crude protein (total nitrogen x 6.25)	18.46	17.72	9.11
True albuminoids (albuminoid N x 6.25)	[14.35]	[12.90]	[6.85]
	100.00	100.00	100.00

The Russian thistle compares in some respects very favorably with red clover, alsike clover, pea fodder, and prickly comfrey; but it must be remembered that chemical analysis alone is not to be relied upon in judging of the real value of a fodder.

The Russian thistle in its native home (pp. 30–33).—The author reports having observed the Russian thistle in various provinces of southern and southeastern Russia, and says that it is not there regarded as a particularly noxious weed. The farmers there sow their cereals quite early and thickly, and the thick shading of the plants prevents progress of weed development until harvest. Immediately after harvest the stubble is turned under and the weeds destroyed in this manner.

The only spots where the plant has made considerable headway are in the "cattle wallows," much like the "buffalo wallows" of the Northwest. In these spots the largest and best plants were found. As compared with some other weeds, as quack grass (*Triticum repens*), true thistles, mulleins, etc., this is not considered a very troublesome weed.

The author is inclined to believe that with care the Russian thistle can be eradicated, or at least held in subjection, easier than the Canada thistle or the oxeye daisy.

The Russian thistle, C. S. CRANDALL (*Colorado Sta. Bul. 28, pp. 12, figs. 8*).—A popular and scientific bulletin describing the Russian thistle (*Salsola kali tragus*). This weed has been reported in 17 counties in Colorado, and attention is called to it in order that its spread may be hindered as much as possible. In addition to the Russian thistle 2 other common tumbleweeds are figured that they may not be confused with it, viz, the common tumbleweed (*Amaranthus albus*) and the winged pigweed (*Cycloloma platyphyllum*).

The Russian thistle, H. SNYDER (*Minnesota Sta. Bul. 34, pp. 34–36*).—The author has made a study of the Russian thistle to determine its food value and draft upon the soil. When young the thistle is claimed to have a high food value, especially for sheep, which, some claim, are attracted to it merely on account of the salt which it contains. The chemical analysis shows a large percentage of ash material, amounting to nearly one-fifth of the dry weight of the plant. This is a serious objection to its use as a fodder, on account of the alkaline nature of the mineral matter present. One favorable point, as shown by the analysis, is the large amount of nitrogenous matter present, being as much as there is in clover or rape. Of the nitrogen present from 65 to 80 per cent is available in the form of protein. Before the development of the thorns there is not much fiber present, at this time the plant is more valuable as a food than when mature. When the plant is ripe the fiber and mineral matter make up half of its composition, and although rich in nitrogenous matter the former elements greatly reduce its feeding value. The following table shows analyses of plants of different ages:

Composition of the Russian thistle.

	Small and tender.	No thorns.	Thorns out.	Ripe.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent*
Water	82.65	78.59	....	....
Dry matter	17.35	21.41	....	....
	100.00	100.00	....	....
COMPOSITION OF THE DRY MATTER.				
Ash	20.32	21.21	18.25	13.75
Ether extract	3.91	3.18	2.97	3.77
Total nitrogenous matter	17.78	14.71	13.45	12.34
Fiber	16.27	22.45	21.62	37.70
Nitrogen-free extract	41.72	38.45	43.71	32.44
	100.00	100.00	100.00	100.00

The ash analysis shows that the weed has strong foraging powers, there being large amounts of potash and lime taken up by the plant. The draft which the plant makes upon the sodium in the soil is a benefit to alkali lands. The amount of sodium present varies greatly with

conditions, showing that the plant is able to adapt itself to the alkaline conditions of the soil. The ash analysis is as follows:

Composition of the ash.

	Small and tender.	Thorns well out.	Ripe.
	Per cent.	*Per cent.*	*Per cent.*
Total insoluble	1.93	2.43	3.95
Potash	26.82	31.21	27.36
Soda	9.16	4.25	12.46
Lime	26.37	24.55	22.39
Magnesia	9.66	7.66	5.56
Iron oxid	.86	1.01	.85
Phosphates	3.49	4.00	3.11
Sulphates	1.52	1.26	4.39
Carbonates	19.28	20.25	17.34
Chlorids	....	....	1.56
	....	....	98.97

From the time the thorns are out until the plant matures it takes up a large amount of sodium from the soil and only small amounts of other materials, hence it makes its heaviest draft upon the soil while in an immature state, after which it takes but little essential plant food. To prevent this heavy draft upon the soil the plants should be destroyed while young. An ordinary thistle 2 lbs. in weight, covering a square yard, will take more potash and lime from the soil than 2 good crops of wheat from the same area.

Nut grass (Cyperus rotundus) (*U. S. Dept. Agr., Division of Botany Circular 2, pp. 4, fig. 1*).—A description of this weed, a comparison of the growth of nut grass, or coco, and chufa, and methods of destroying coco are given. The methods of exterminating this weed recommended are to plow or hoe the infested field at frequent intervals during the summer so as to prevent the development of any plants or to plant a vigorous shade crop, using crimson clover, winter vetch, or rye to occupy the land during the winter and growing a hoed crop during the summer.

Dodder, C. V. PIPER (*Washington Sta. Bul. 8, pp. 142–144, figs. 2*).—Popular illustrated notes are given on dodder (*Cuscuta arvensis*), with a report on suggested methods for eradication. A solution of sulphate of iron had been recommended to be sprinkled over the alfalfa plants infested by the dodder, but with no success, although it was used as strong as 1 lb. to a gallon of water. A solution of calcium sulphite in water is said to be used in Europe to kill the dodder with perfect success.

DISEASES OF PLANTS.

Leaf curl and plum pockets, G. F. ATKINSON (*New York Cornell Sta. Bul. 73, pp. 319–355, pls. 20*).—The author has made a study of the distortions of the leaves of the genus *Prunus* caused by fungi belonging to the family *Exoasceæ*. The species of this family have been

grouped by Sadebeck into 3 genera, viz, *Magnusiella*, *Taphrina*, and *Exoascus*. In the present paper the author reports on the prunicolous species, which, so far as known, all belong to the genus *Exoascus*. The species of this genus have a perennial mycelium, and a new infection each year is secured by the mycelium wintering in the tissues of the host and by spores.

Definite and conclusive experiments have not yet been made concerning the treatment and the control of the disease caused by the various species of *Exoasceæ*. On account of the perennial mycelium, a tree once infected is liable to show the disease more or less every year. No buds should be taken from infected trees for budding nursery stock or in the orchard. Since nearly all the affected leaves of peach trees fall away before the time of the selection of buds, the trees should be carefully selected in the months of May and June in order to avoid those which have the disease. Where only a few branches of a tree are affected, pruning a considerable distance below the affected portion might be tried, especially in the case of those plum trees having the bud deformation.

The author gives a list of the species of *Exoascus* described as occurring on species of *Prunus* in the United States with their hosts:

"*Exoascus deformans*, deforming the leaves and rarely the shoots of *Prunus persica; E. pruni*, deforming the fruit, causing 'bladders' or plum 'pockets' of *P. domestica; E. insititiæ*, causing 'witches brooms' and deforming the leaves of *P. pennsylvanica; E. cerasi*, causing 'witches brooms' and deforming the same on *P. avium; E. confusus*, deforming the fruit and floral envelopes of *P. virginiana; E. farlowii*, deforming the fruit and floral envelopes of *P. serotina; E. communis*, deforming the fruits of *P. maritima, P. pumila, P. americana*, and *P. nigra; E. longipes*, deforming the fruit of *P. americana; E. mirabilis*, deforming the leaf buds and twigs, forming 'pockets,' of *P. angustifolia, P. hortulana*, and *P. americana; E. mirabilis tortilis*, distorting the fruit of *P. angustifolia; E. rhizipes*, deforming the fruit and leaf buds of *P. triflora; E. decipiens*, deforming the leaves and shoots of *P. americana; E. decipiens superficialis*, deforming the surface of the fruit of *P. americana; E. varius*, deforming the leaves and shoots of *P. serotina* and *P. demissa (?); E. cecidomophilus*, affecting cecidomid galls on the fruit of *P. virginiana*."

Of this list the following are given as new species: *Exoascus varius, E. mirabilis, E. mirabilis tortilis, E. longipes, E. decipiens, E. decipiens superficialis, E. rhizipes, E. confusus*, and *E. cecidomophilus*.

Journal of Mycology (*U. S. Dept. Agr., Division of Vegetable Pathology, Journal of Mycology, vol. VII, No. 4, pp. 333–478, pls. 7*).—Briefly summarized, the contents of this number consist of the following:

Treatment of pear-leaf blight in the orchard, M. B. Waite (pp. 333–338).—Experiments were conducted in an orchard containing about 16,000 trees, mostly Bartletts, near Scotland, Virginia, for the prevention of pear-leaf blight (*Entomosporium maculatum*). In 1892 5 sprayings of Bordeaux mixture were given about 160 trees, resulting in entirely preventing the disease. The dates of application were April 28, May 15 and 30, and June 14 and 29. Owing to the satisfactory results obtained in 1892, in 1893 the owners decided to spray the entire orchard.

In doing this plats were given varying numbers of sprayings, ranging from 1 to 4, to test the number and time of applications necessary. The earliest treatments gave the poorest results. Two sprayings, on May 1 and 15, or May 1 and June 1, gave results that indicate 2 sprayings are sufficient treatment. Additional applications gave only slight improvement over those receiving but 2 sprayings. It is recommended that the first spraying should be delayed until late in the spring, so as to have the leaves well covered at the time of the first attack of the fungus, and the second application should be given just before the principal attack and late enough to last throughout the season. The method of treatment of the orchard as a whole is given in detail. The cost of spraying the orchard 4 times was $522 for the 16,000 trees, or about $2.56 per acre. As it is shown that 2 applications are sufficient, the cost may be reduced one-half.

Experiments with fungicides to prevent leaf blight of nursery stock, D. G. Fairchild (pp. 338–353).—A report is given of the details of experiments carried on at Geneva, New York, in coöperation with S. A. Beach, of the New York State Experiment Station, who has already reported in part upon this work.[1] The experiments here reported on were conducted with pear seedlings. In all, 25 mixtures of fungicides were used, the formulas and reactions of which are given. Of these mixtures the only ones that did not injure the foliage and retarded to some degree the progress of the disease were copper acetate, copper borate, copper carbonate, copper ferrocyanid, copper hydrate, copper phosphate, copper silicate, and eau celeste with soap. The author is of the opinion that had Bordeaux mixture been tried it would have proved superior to any of those used. Notes are also given on the treatment of horse-chestnut leaf blight (*Phyllosticta sphæropsoidea*). The preliminary experiment warranted the recommendation of Bordeaux mixture as a preventive of this disease.

Prune rust, N. B. Pierce (pp. 354–363).—Notes are given on the distribution and action of prune rust (*Puccinia pruni*) on the stocks. It is reported as affecting the prune, plum, peach, nectarine, apricot, cherry, and almond. Experiments were conducted in one orchard with modified eau celeste, while in another modified eau celeste and ammoniacal copper carbonate were used. A striking contrast was noted at the end of the season in comparing the sprayed with the check trees, proving the efficacy of the treatment. All things considered, ammoniacal copper carbonate is preferred to the eau celeste. The number of applications necessary can not be definitely stated, but 2, if thoroughly applied, will usually suffice. The cost will be about 3 cts. per tree for each application.

Preliminary notice of a fungus parasite on Aleyrodes citri, H. J. Webber (pp. 363, 364).—The author reports finding a fungus attacking *Aleyrodes citri* and it has been provisonally determined as *Aschersonia tahitensis.*

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[1] N. Y. State Sta. Bul. 72; E. S. R., 6, p. 302.

A species of *Aschersonia*, probably the same as the above, is reported as parasitic on *Lecanium* sp. on the sweet bay tree. Whether this fungus can be spread rapidly enough to materially check the ravages of the insects remains for further inquiry.

An improved method of making Bordeaux mixture, W. T. Swingle (pp. 365-371).—Stock solutions, 2 lbs. of copper sulphate and milk of lime to the gallon are recommended. These may be sufficiently diluted and mixed. When mixed the solution should not be allowed to stand long before using, as it deteriorates rapidly. When properly prepared Bordeaux mixture should be a clear sky blue in color. Such a mixture is alkaline, and a thin pellicle of calcium carbonate will form over the surface upon exposure to the air. Adding soap aids in causing the mixture to spread. For this purpose some of the cheaper soaps answer very well. The soap should be added in solution and in sufficient quantity to foam when thoroughly stirred.

A new method of treating grain by the Jensen process for the prevention of smut, B. T. Galloway (pp. 372, 373).—The author describes a method devised by Mr. E. Bartholomew for the hot-water treatment for oat smut. It consists essentially in an open barrel arranged to draw off the water near the bottom. Within the barrel a perforated cylinder is so placed as not to reach the bottom of the barrel by 3 or 4 in., and extending above the top about the same distance. A section of stovepipe will answer. Within the barrel and around the cylinder the oats are placed, and water heated to 130° F. is poured into the cylinder until all the oats are covered. After standing for 10 minutes the water is drawn off below, heated again, and poured back. This is repeated 3 or 4 times. From such treated seed one-tenth of 1 per cent smutted oats were obtained, as compared with 20 per cent from untreated seed.

Field notes for 1892, E. F. Smith (pp. 373–377).—Brief notes are given on a new melon disease due to an *Alternaria* or *Macrosporium*, on perithecia of grape downy mildew found before frost, occurrence of apple scab, pear blight, gooseberry-leaf blight, black spot of peach, spot of peach probably due to *Cercospora*, peach mildew, peach curl, wilting of peaches on the tree, stem and root galls, and root rot of the peach due possibly to *Armillaria mellea*.

Review of recent literature (pp. 378–398).—An injury of rose leaves due to asphalt vapor, H. Alten and W. Jännicke; Handbook of Australian fungi, M. C. Cooke; A botanical excursion in the Tropics, G. Haberlandt; A mosaic disease of tobacco, A. Mayer; On the dimorphism of the root tubercles of the pea, H. Moeller; Report on recent experiments in checking the potato disease in the United Kingdom and abroad; Root symbiosis of *Mycorrhizæ*, G. F. L. Sarauw; Comparative morphology of fungi, F. von Tavel; and The diseases of conifers, H. M. Ward.

Errata (p. 399).—A list is given of corrections and additions to be made to the index of current literature.

Index to literature (pp. 400–430).—The index to mycological literature is continued, the numbers running from 1002 to 1292. The articles listed appeared during the years 1890, 1891, and 1892.

An index to volume 7 completes the number.

Bordeaux mixture as a fungicide, D. G. FAIRCHILD (*U. S. Dept. Agr., Division of Vegetable Pathology Bul. 6, pp. 55*).—The author has sought to give the present status of our knowledge concerning Bordeaux mixture. According to the history given of the fungicide it originated in the neighborhood of Médoc, France, where it was first used as a thick paste, sprinkled over the grapevines to prevent pillaging. It is not known how long this practice had been followed, but Millardet, professor of botany in the Bordeaux faculty of sciences, began experiments in 1883 with it as a means for the prevention of mildew, since which time its value as one of the best fungicides has become well established. While the discovery is due to the French, it is to Americans that its extended use must be attributed, as in no other country is it as extensively used or for as many diseases as here.

Various formulas and directions for the preparation of Bordeaux mixture are given. The tendency seems to be toward the use of more dilute solutions than formerly.

The chemistry, fungicidal action, and toxicology of Bordeaux mixture are reviewed at considerable length.

The combination of Bordeaux mixture with insecticides is mentioned. Where arsenites are used an insoluble arsenite will be formed, and this will adhere to the fruit as long as the Bordeaux mixture does. On this account the author thinks this phase should be investigated further before unrestricted recommendations of such combinations be advised.

The efficiency of Bordeaux mixture as a fungicide is pointed out. It embraces the requisites of fungicidal power without injury to foliage to a greater degree than any other combination. It must not, however, be considered a panacea for all plant ills without a greater number of experiments. The author reviews the various diseases that have been treated with Bordeaux mixture. It may be considered as the best fungicide, in some cases amounting to a specific, for the following diseases: Downy mildew of the grape (*Plasmopara viticola*), black rot of the grape (*Guignardia bidwellii*), leaf blight of pears and quinces (*Entomosporium maculatum*), pear scab (*Fusicladium pyrinum*), leaf blight of plums and cherries (*Cylindrosporium padi*), plum-leaf rust (*Puccinia pruni*), bitter rot of apples (*Glœosporium fructigenum*), apple scab (*Fusicladium dendriticum*), strawberry-leaf blight (*Sphærella fragariæ*), potato rot (*Phytophthora infestans*), potato-leaf blight or macrosporium disease (*Macrosporium solani*), bean anthracnose (*Colletotrichum lindemuthianum*), black rot of the tomato (*Macrosporium solani*), downy mildew of the beet (*Peronospora schachtii*), mignonette-leaf blight (*Cercospora resedæ*), and leaf spot of chrysanthemums (*Septoria* sp.).

In the case of the following diseases the evidence is lacking to demon-

strate the efficiency of Bordeaux mixture as a preventive, or at least as the best fungicide to be employed. In some cases it has failed entirely:

Powdery mildew or oïdium of the grape (*Uncinula necator*), anthracnose of the grape (*Glœosporium ampelophagum*), peach-leaf curl (*Taphrina deformans*), peach rot (*Monilia fructigena*), gooseberry powdery mildew (*Sphærotheca morsuvæ*), currant-leaf spot (*Septoria ribis*), raspberry anthracnose (*Glœosporium venetum*), potato scab (*Oöspora scabies*), downy mildew of the tomato (*Phytophthora infestans*), cranberry gall fungus (*Synchytrium vaccinii*), cranberry scald, loose smut of wheat (*Ustilago tritici*), stinking smuts of wheat (*Tilletia fœtens* and *T. tritica*), corn smut (*Ustilago maydis*), and rusts of cereals (*Puccinia rubigo-vera*, *P. coronata*, and *P. graminis*).

Treatment for oat smut, A. A. MILLS (*Utah Sta. Rpt. 1893, pp. 225–228*).—Two years' experiments were conducted with the Jensen or hot water and potassium sulphid treatment for oat smut. The directions for the Jensen treatment[1] are quoted.

The potassium sulphid treatment consisted in soaking the seed for 24 hours in a solution of 1 lb. of potassium sulphid to 24 gal. of water, or for 12 hours in a solution of 1 lb. of potassium sulphid to 12 gal. of water. Tabulated results are given showing that for the average of the two years the yield of grain and straw from the plats given the hot-water treatment was in advance of the others, and that plats given the potassium sulphid treatment were far in advance of the ones not treated. In none of the treated plats was there any smut, while the check plats contained considerable. Further trials are to be continued before definite conclusions are drawn, but the author thinks that the potassium sulphid very materially increases the yield both of grain and straw.

Insecticides and fungicides, P. H. ROLFS (*Florida Sta. Bul. 23, pp. 36*).—Popular information is given on the preparation and application of fungicides and insecticides. Formulas are given for Bordeaux mixture, eau celeste, ammoniacal copper carbonate, potassium sulphid, and directions for hot-water treatment of oats for oat smut. Among the insecticides formulas are given for Paris green, London purple, kerosene emulsion, resin washes, sulphur spray, pyrethrum, tobacco decoction, naphthalin, bisulphid of carbon and lime, salt and sulphur mixture. Directions are also given for combining fungicides and insecticides. Insecticides that have been tested at the station and found to be of no value for the purpose for which they are recommended are salt, decoction of Jamestown weed, decoction of China-tree leaves, and China-tree berries. A list of the chemicals, together with their retail prices, is given. The bulletin concludes with a table giving directions for the use of fungicides and insecticides.

Morphology and anatomy of leaves and shoots deformed by Exoasceæ (cont.), W. G. SMITH (*Forstl. naturw. Ztschr., 3 (1894), No. 12, pp. 473–482*).

[1] U. S. Dept. of Agr., Farmers' Bulletin 5; E. S. R., 3, p. 631.

Recent observations on brunissure caused by the puncture of insects, J. PASTRE (*Prog. Agr. et Vit., 11 (1894), No. 47, pp. 547–551*).

Cladosporium herbarum and other fungi common to cereals, E. JANCZEWSKI (*Bul. Acad. Sci. Cracovie, 1894, June, pp. 45; abs. in Bot. Ztg., 52 (1894), II, No. 23, pp. 359–361*).

Contributions to an economic knowledge of Australian rusts, N. A. COBB (*Dept. Agr. N. S. W., Misc. Pub. 18, pp. 14, figs. 4*).—Notes and suggestions for improving strains of wheat by careful selection in regard to stock, foliage, and seed, with remarks on harvesting.

On predisposition of grain to rust, E. HENNING (*Kgl. Landt. Akad. Handl. Tidskr., 33 (1894), pp. 205–217*).

Mangel and beet rust (Uromyces betæ) (*Sugar, 7 (1894), No. 2, p. 17*).

The Oïdium on grapes, J. A. DESPEISSIS (*Agl. Gaz. N. S. W., 5 (1894), No. 10, pp. 701, 702*).

A supposed new disease of the vine, G. COUANON (*Bul. Min. Agr. France, 13 (1894), No. 6. pp. 568–571*).

Common fungus diseases and methods of prevention, C. V. PIPER (*Washington Sta. Bul. 8, pp. 131-141*).—A popular bulletin on the preparation and application of fungicides for the following diseases: Loose smut of oats (*Ustilago avenæ*), stinking smut of wheat (*Tilletia fœtens*), potato rot (*Phytophthora infestans*), potato scab (*Oöspora scabies*), apple scab (*Fusicladium dendriticum*), twig blight of pear and apple (*Bacillus amylovorus*), pear blight (*Fusicladium pyrinum*), pear-leaf blight (*Entomosporium maculatum*), peach-leaf curl (*Taphrina deformans*), peach mildew (*Sphærotheca* sp. ?), black knot (*Plowrightia morbosa*), and strawberry-leaf blight (*Sphærella fragariæ*).

Notes on fungi, T. A. WILLIAMS (*South Dakota Sta. Rpt. 1892, pp. 24*).—Reprinted from Bulletin 29 of the station (E. S. R., 4, p. 50).

Injurious fungi and insects (*Jour. [British] Bd. Agr., 1 (1894), No. 2, pp. 199–217*).—Illustrated descriptive notes are given on rust of wheat, Bordeaux mixture and potato rot (*Macrosporium solani*), celery fly (*Tephritis onopordinis*), celery-stem fly (*Piophila apii*), and codling moth (*Capocapsa pomonella*).

Investigation upon cane pests (*Rpt. Exptl. Fields, Dodds Reformatory, Barbados, 1893, pp. 44–50*).—Report on fungus and insect enemies of sugar cane.

Diseases and insect enemies of sugar beets (*Abs. in Sucrerie indigène, 44 (1894), No. 26, pp. 747–750*).—In response to inquiries it is learned that *Phoma betæ* among fungi and the larvæ of *Agrostis segetum* are the worst enemies of the sugar beet, followed by *Heterodera schactii*, *Tylenchus* sp., and *Leptosphæria circinens*.

Cane disease in South Queensland (*Sugar, 7 (1894), No. 2, p. 25*).—An account of gumming of cane due to *Bacillus vascularum*, probably identical with *B. sacchari*, causing a similar disease in Java.

Experiments on potato blight made in 1894, M. MONTANARI (*Staz. Sper. Agr. Ital., 27 (1894), No. 3, pp. 251–261*).

Quicklime for a root disease (Rhizoctonia medicaginis) of alfalfa, L. MANGIN (*Jour. Agr. Prat., 58 (1894), No. 52, pp. 921, 922*).

Copper sulphate and potatoes (*Gard. Chron., 16 (1894), ser. 3, p. 697*).—Spraying the potatoes with solution of copper sulphate gave an increased yield of 3 to 5 tons per acre.

Spraying for black knot of cherries and plums, E. G. LODEMAN (*Garden and Forest, 7 (1894), pp. 508–509*).

The ferrocyanid test for Bordeaux mixture, L. R. JONES (*Garden and Forest, 7 (1894), p. 497*).—The author thinks mixtures made by this method should be more thoroughly tested before being recommended for general use in the orchard.

ENTOMOLOGY.

The carpet beetle, or Buffalo moth, L. O. HOWARD (*U. S. Dept. Agr., Division of Entomology Circular 5, 2d ser., pp. 4, fig. 1*).—Notes, chiefly compiled, on the history, distribution, habits, and treatment of *Anthrenus scrophulariæ*. Since the introduction of this small black beetle from Europe in 1874 it has spread over most of the Northern States. The adults issue throughout the fall, winter, and spring, and after laying their eggs migrate to various scrophulariaceous and composite plants. There are usually 2 annual generations, and the larvæ work under carpets and woolen goods, making irregular holes or long slits.

Where the presence of the pest is noticed, thorough and long continued measures must be taken to eradicate it. Carpets must be taken up, beaten, and sprayed with benzin, out of doors, and the floors thoroughly swept, dusted, and washed down with hot water, after which kerosene or benzin is to be poured into the cracks and sprayed under the baseboards. Before relaying carpets tarred roofing paper should be laid on the floor, at least around the edges. Local attacks may be checked by laying a damp cloth smoothly over the part of the carpet attacked and ironing it with a hot iron, when the steam will kill the larvæ immediately beneath. The discarding of carpets, to be replaced by polished floors and rugs, is advocated.

The chestnut and its weevil, G. MCCARTHY (*North Carolina Sta. Bul. 105, pp. 267–272*).—To learn the present condition of the chestnut industry a circular was sent to about 100 persons in the State and to horticulturists and entomologists in other States, soliciting information in regard to the chestnut weevil, its prevalence, ravages, and treatment. Abstracts of 15 replies are cited and descriptive and life history notes and remedies for the weevil are given.

The chestnut weevil (*Balaninus proboscoideus*) is about the size of the pea weevil, yellowish, with rusty spots and lines on the wing covers, and possessing a snout in the female twice the length of the body and somewhat shorter in the male. The white cylindrical grub is about $\frac{1}{2}$ in. long when full grown. The beetles appear on the chestnut trees during the blossoming season or a little later, and from 1 to 4 eggs are laid in each burr. There is but 1 brood a year. The grub reaches maturity soon after the ripening of the nuts and usually escapes shortly after the burr falls to the ground. It enters the ground, where it changes to the pupa state, emerging as the adult in the following spring.

As remedies hand picking is advised and further assorting the nuts by throwing them into water, when the infested ones will float and may be skimmed off. Storing the nuts in tight boxes immediately after gathering and in 2 weeks treating them with carbon bisulphid is proposed, and also spraying the trees soon after blooming with London purple or Paris green, 1 lb. to 200 gal. of water, and jarring the trees during the blooming period.

Two injurious insects, C. V. PIPER (*Washington Sta. Bul. 7, pp. 121–127*).—Descriptive and life history notes on the pea weevil (*Bruchus pisi*) and cottony maple scale (*Pulvinaria innumerabilis*), with remedies and treatment. It is recommended that infested peas be inclosed in air-tight boxes and treated for 24 hours to the fumes of carbon bisulphid or immersed for 1½ minutes in water at a temperature of 145° F., or else kept for two years in tight bags or boxes, during which time the beetles will emerge and die.

Against the cottony maple scale spraying with kerosene emulsion in May and June is advised. It may be necessary to make two sprayings a fortnight apart.

Some general remarks to farmers in regard to insects are added, and directions given for sending insects to the station.

Insect Life (*U. S. Dept. Agr., Division of Entomology, Insect Life, vol. VII, No. 1, pp. 1–54, figs. 17*).—*The cranberry girdler, S. H. Scudder* (pp. 1–5).—Notes on the life history of *Crambus topiarius*, of which technical descriptions and figures are given. The moth lays its eggs in the early part of July on the cranberry plants, and the larvæ, which hatch in about 7 days, quickly form filmy silk galleries along the prostrate stems or runners, in which they eat, girdling the stems and destroying the vital parts of the plants. They form coarse cocoons of mingled sand and silk at the surface of the ground in November, but do not change to chrysalids until the following spring. As it is found that the caterpillars within their cocoons can withstand submergence during the entire winter, it is advised that the crop be picked early in October and the bog then flooded for a fortnight.

Two parasites of important scale insects, L. O. Howard (pp. 5–8).—Illustrated and technical descriptions of *Prospalta murtfeldtii* and *Ablerus clisiocampæ*, new genera and species of Hymenoptera attacking *Aspidiotus uvæ* and *Chionaspis furfurus*.

The buffalo tree hopper, C. L. Marlatt (pp. 8–14).—Illustrated and descriptive notes on the life histories of the true buffalo tree hopper (*Ceresa bubalus*) and an allied species, *C. taurina*. The first species is variously injurious in orchards in the West, depositing its eggs under the bark by making longitudinal series of short, nearly parallel slits, in two lines, in the twigs. The injury causes the limbs to become very scabby and rough, easily broken by the wind, and liable to attack by wood-boring insects. In addition to orchard trees, the willow, cottonwood, maple, and various garden vegetables and weeds are fed upon by the larvæ. The only remedial measures recommended are preventive ones by limiting foreign vegetation about and in orchards and nurseries and vigorously pruning the punctured limbs.

Supplementary notes on the strawberry weevil, its habits and remedies, F. H. Chittenden (pp. 14–23).—Notes on the distribution, prevalence, habits, and life history of *Anthonomus signatus* and details of experiments for its destruction, with remedies against it. The weevil appears

about the middle of April, and before the blooming of the strawberries is found to feed upon the redbud, or Judas tree (*Cercis canadensis*). An egg is laid in each blossom before opening and the stem of the bud is then nearly severed.

Spraying the strawberry plants a day or two before blooming and about two other applications at intervals of a few days after blossoming, either arsenicals or kerosene emulsion being used, is advised, as also planting trap trees of redbud in the vicinity of strawberry fields, whence the beetles may be jarred and caught on sheets saturated with kerosene. Brushwood and weeds in the vicinity of strawberry fields should be burned in the early spring to destroy any weevils that they may harbor.

Occurrence of the hen flea (*Sarcopsylla gallinacea*) *in Florida, A. S. Packard* (pp. 23, 24).—Illustrated note on the discovery in Florida of this species, which is thus shown to be cosmopolitan.

Notes on cotton insects found in Mississippi, W. H. Ashmead (pp. 25–29).—The first part of a paper giving an annotated list of cotton insects observed by the writer. The Orthoptera, Thysanoptera, and Neuroptera are noted, and some of the Platyptera. *Thrips trifasciatus* and *Psocus gossypii* are described as new species.

On a Lecanium infesting blackberry, considered identical with L. fitchii, T. D. A. Cockerell (pp. 29–31).—Critical and descriptive notes on this species.

Insects injuring drugs at the University of Kansas, V. L. Kellogg (pp. 31, 32).—Notes on 11 insects attacking various drugs in the rooms and laboratories of the department of pharmacy. *Sitrodrepa panicea* was the most abundant and widespread. Tight jars and canisters are recommended, and exposing infested drugs to the vapor of carbon bisulphid.

The senses of insects, C. V. Riley (pp. 33–41).—An illustrated popular article describing the sight, touch, taste, smell, and hearing of various insects and comparing them with the analogous senses in man, with notes on special sense organs, the antennæ, and the power possessed by many female insects to attract the males from great distances.

A new species of Pezotettix, L. Bruner (pp. 41, 42).—Technical description and note on *P. chenopodii.*

A maritime species of Coccidæ, T. D. A. Cockerell (pp. 42–44).—Note on *Ripersia maritima*, which was found on the roots of *Spartina* between tide marks on Long Island, and is technically described as new.

An abnormal tiger swallowtail, L. O. Howard (pp. 44–47).—Illustrated description of a peculiar male specimen of *Papilio turnus glaucus*, which embraces many female characteristics in its coloration.

Among general notes and notes from correspondence the following may be mentioned: A new apple-tree enemy, the black Australian ladybird in California, the grapevine-root worm, an invasion of the "feathered Gothic" moth in northern France, taxonomic value of the

scales of Lepidoptera, death web of young trout, *Pollinia costæ* in California, the leaf-footed bug attacking plums, is *Icerya* an Australian genus? the cottonwood-leaf beetle in New York, resin wash against the grape aspidiotus, a scale insect on laurel oak, root webworm in Pennsylvania, and the horn fly attacking horses.

Descriptions of some new North American Homopterous insects, E. P. VAN DUZEE (*Buffalo Soc. Nat. Sci. Bul., vol. V, No. 4, pp. 205–216.*)—Descriptions and habitat of the following 17 new species: *Idiocerus nervatus*, *Platymetopius loricatus*, *P. fuscifrons*, *Allygus costomaculatus*, *Deltocephalus fuscinervosus*, *D. concentricus*, *Athysanus gammaroides*, *Eutettix southwicki*, *E. slossoni*, *Scaphoideus luteolus*, *S. lobatus*, *Thamnotettix perpunctata*, *T. aureola*, *Tinobregmus vittatus*, *Xestocephalus pulicarius*, *X. fulvocapitatus*, and *X. tessellatus*. *Tinobregmus* and *Xestocephalus* are described as new genera.

Effect of carbon bisulphid on the yield of crops, A. GIRARD (*Soc. Nat. Agr. [France]; abs. in Jour. [British] Bd. Agr., 1 (1894), No. 1, pp. 73–75*).—In view of the increasing use of bisulphid of carbon for the destruction of subterranean insects, as root lice, root maggots, white grubs, ants in their nests, etc., a knowledge of the effects of this substance on soils and vegetation becomes important. That it will destroy plant life when used excessively is abundantly proven with the phylloxera of the grape in Europe. In the first experiment with this substance vines were frequently killed by overdosing, and the *traitement d'extinction*, as employed in Switzerland and some other European countries outside of France, consists in using it in such quantities that the infested vines and lice are destroyed at the same time. L. O. Howard states that in an experience of his in destroying an ant nest the grass immediately surrounding was killed. With these facts in mind it is interesting to note that this substance seems to have a strikingly beneficial effect on the soil in greatly increasing its fertility. This seems to be conclusively shown in an elaborate series of experiments conducted by the author and extending over a number of years. Attention was first called to this action by the results following an attempt to destroy a mematode (*Heterodera schachtii*) upon the roots of the sugar beet. To kill the parasite, protected as it was in the substance of the beet, it was necessary to use the bisulphid at the rate of 9½ oz. to the square yard, or 2,904 lbs. to the acre, which resulted also in the complete sacrifice of the beet crop. Wheat grown on the same field the year following, however, exhibited a remarkable superiority throughout the tract treated with the insecticide, and this led in the following years to a series of trials at the same rate per square yard, with the following results:

"Comparing the sulphureted plats with the check plats, it appears that on the former areas there was an increased yield of wheat, ranging from 15 to 46 per cent in the grain and from 21 to 80 per cent in the straw. Potatoes on the sulphureted plats gave an increased yield of from 5 to 38 per cent, and the production of beet

root was from 18 to 29 per cent greater than the yield obtained on the check plats. Clover gave an increased yield on the treated areas, ranging from 67 to 119 per cent; and in the case of oats the treatment produced, in 1891, an increase of 9 per cent in the grain and 30 per cent in the straw; while at Joinville, in 1892, the oats on the sulphureted plats are stated to have shown an increase of 100 per cent in grain and 60 per cent in straw."

The results the second year after the original treatment, without further additions of the bisulphid or use of fertilizers, were as marked as in the first year's crops. The explanation of this increased vigor of plant growth is not altogether satisfactory. It is supposed that the bisulphid acts as a stimulant to vegetation and also poisons subterranean insects or other organisms, cryptogamic, perhaps, which otherwise would injuriously affect the roots of plants. It may also exert some chemical action on the soil elements, resulting in their easier assimilation by plants.

This latter opinion is held by C. Oberlin, an Alsatian viticulturist,[1] who independently conducted a series of experiments and reports results similar to those obtained by Girard in the increased production of vegetables, cereals, and forage crops on land which had been subjected to the *traitement d'extinction* referred to above. M. Whitney, of this Department, suggests that there may also result an alteration in the physical character of the soil which will explain the results obtained.

These results, with accompanying explanations, are in contrast with, but not necessarily contradictory to, the commonly held idea that the use of bisulphid of carbon is liable to stop the nitrification or conversion into plant food of the vegetable matters in the soil by destroying the microscopic germs which bring this about. That there is a checking of nitrification by the destruction of these germs or bacteria by the use of the bisulphid has been fully established by the experiments of Warington, and more recently by J. Perraud,[2] but there can now be no doubt that the beneficial effect in some one or more of the directions mentioned more than offsets any retardation in the action of ferments on nitrogenous fertilizers. A treatment as strong as that given by Girard is impractical, costing, in fact, $96 per acre at the very low price (3⅓ cts. per pound) of the chemical in France, and at our rate (10 cts. per pound) three times as much. But this experiment indicates, at least, that benefit rather than injury to the soil in its productive capacity is to be anticipated where the substance is employed in the ordinary application in vineyards, or at about one-tenth the rate given above, viz, a little less than 1 oz. to the square yard, or 290 lbs. to the acre, with a minimum rate of 175 lbs. to the acre.

The use of the bisulphid in this country in garden or vineyard operations can not become very general as long as the present prices are main-

[1] Rev. Internat. Vit. et Œnol., 1 (1894), No. 7, pp. 278–280.

[2] Rev. Vit., 1894, May 5 and 12, and Rev. Internat. Vit. et Œnol., 1 (1894), No. 8, pp. 307–315.

tained, and it is to be hoped that the increasing demand for it as an insecticide will lead to competition in its manufacture and a reduction in price more in accord with that obtaining in Europe.—C. L. MARLATT.

Experiments with remedies against the Nonne (Liparis monacha) (*Ztschr. Forst- und Jagdw., 26 (1894), No. 3, pp. 125–139*).—A report of the royal provincial government at Oppeln, Silesia, to the Minister of Agriculture. Multitudes of the caterpillars were destroyed by *flâcherie* and also by parasitic Tachina flies, which were exceedingly abundant, and on this account the results of experiments with different insecticides were interfered with and obscured. Numerous experiments were carried on with insect lime, with unsatisfactory results, which go to prove that insect lime, though oftentimes advantageous, is not a remedy to be relied upon in the height of an insect irruption. A series of experiments undertaken toward inoculating the caterpillars with a bacterial disease, contrary to expectations, gave negative results.

Bee fertilization of fruit blossoms, E. GERMAIN (*U. S. Consular Rpt. 1894, Oct., p. 202*).—A popular note on an experiment made in Switzerland in regard to this well-known fact. Blossoms of various fruit trees and vegetables covered with gauze during the blooming season set no fruit.

History of the silk trade and silk industry from antiquity to the end of the Middle Ages, T. YOSHIDA (*Entwickelung des Seidenhandels und der Seidenindustrie vom Alterthum bis zum Ausgang des Mittelalters. Heidelberg: J. Hörning, 1894, pp. VII+111*).—This treatise gives a complete and detailed historical sketch of the origin and pursuit of silk growing, which is more scientifically and fully treated than in previous works on this subject. Of special interest is the author's sketch of the origin and development of silk culture in China and Japan, its introduction into Europe, and his careful description of the ancient trade routes between Central Asia and the Roman Empire.

The chigoe in Asia, W. F. H. BLANDFORD (*Ent. Monthly Mag., 2d ser., 5 (1894), No. 58, pp. 228–230*).—Descriptive and geographical notes on *Sarcopsylla penetrans*.

Notes on the migratory locust of the Argentine Republic, E. C. REED (*Proc. Ent. Soc. London, 1893, pp. XXI–XXIV*).—Brief note on an invasion of a species believed to be *Acridium paracense* or *A. cancellatum*.

A flight of locusts, E. ARNOLD (*Ent. News, 5 (1894), No. 8, pp. 237–239, from Daily Telegram, London*).—A popular description of an invasion witnessed by the author in Palestine.

Catalogue of the Lepidoptera of Norway, W. M. SCHÖYEN (*Christiania, 1894, pp. 54*).

The codling moth, J. B. SMITH (*Ent. News, 5 (1894), No. 9, pp. 284–286*).—Notes on observations of this species, which go to show that in New Jersey there is but one brood a year.

The codling moth, E. S. RICHMAN (*Utah Sta. Rpt. 1893, pp. 199, 200*).—Popular descriptive and life-history notes on the codling moth, with detailed directions for spraying with Paris green.

The Coccidæ found on ivy, T. D. A. COCKERELL (*Ent. News, 5 (1894), No. 7, pp. 210–212*).—Notes on *Phenacoccus hederæ, Lecanium maculatum, L. hesperidum, Aspidiotus hederæ,* and *Asterolecanium hederæ* occurring on *Hedera helix*.

Number of annual broods in Harpiphorus maculatus, F. M. WEBSTER (*Ent. News, 5 (1894), No. 9, pp. 275, 276*).—Notes on studies of the strawberry sawfly in Indiana. In the northern part of the State it is single brooded, while in the middle and southern portions there are two broods in a year.

A report on the ravages of Heliophobus popularis, P. Marchal (*Bul. Min. Agr. France, 13 (1894), No. 6, pp. 565–567*).

The Hessian fly in New Zealand, T. W. Kirk (*New Zealand Dept. Agr. Rpt. 1894, p. 81*).

Insects injuring mushrooms, V. Mayet (*Prog. Agr. et Vit., 11 (1894), No. 44, pp. 468–475, pl. 1*).

On an insect which attacks dried mushrooms and fungi, and the means of destroying it, R. Moniez (*Rev. Biol. nord France, 6 (1894), No. 9, pp. 325–328*).—Notes on the habits of *Tinea granella*, the larvæ of which are frequently destructive. Heat for several hours is recommended.

The potato moth in New Zealand, T. W. Kirk (*New Zealand Dept. Agr. Rpt. 1894, p. 88*).

An insect pest of sugar cane, W. Fawcett (*Bul. Bot. Dept. Jamaica, 1 (1894), No. 8 and 9, pp. 126–131*).—Notes on the life history, parasites, and treatment of the moth borer (*Chilo saccharalis*).

Some insect enemies of the pine, L. Dufour and R. Hickel (*Rev. gén. Bot., 6 (1894), No. 71, pp. 433–445*).—Description and notes on *Lasiocampa pini*, *Retinia buoliana*, *Fidonia piniaria*, and *Lophyrus rufus*, with suggested means for their destruction.

Pineapple spruce gall, L. Barron (*Amer. Gard., 15 (1894), No. 28, p. 501*).—Illustrated notes of a gall on spruce twigs, caused by *Chermes abietis-laricis*.

Notes on some species of Tyroglyphidæ which feed upon articles of food and drugs, R. Moniez (*Rev. Biol. nord France, 6 (1894), No. 12, pp. 442–459*).—Descriptive and life-history notes on 15 species.

Notes on the larva of Ephestia elutella, G. C. Bignell (*Ent. Monthly Mag., 2d ser., 5 (1894), No. 56, p. 185*).—Brief descriptive note, and remarks on injury to biscuits.

Some inmates of a decayed cherry tree, C. J. Watkins (*The Entomologist, 27 (1894), No. 377, pp. 284–287*).—Notes on an interesting collection of insects found on a careful examination of a cherry stump, with some remarks on life histories. There were found 414 specimens, belonging to 49 species and 6 orders.

A list of the Hemiptera of Buffalo and vicinity, E. P. van Duzee (*Buffalo Soc. Nat. Sci. Bul., vol. V, No. 4, pp. 1, 6, 7, 205*).—An annotated local catalogue, comprising 381 species, representing 195 genera. An index is given to the genera.

Introduced insects, J. B. Smith (*Ent. News, 5 (1894), No. 10, pp. 311, 312*).—General remarks on the subject, with recommendations that imported nursery stock be washed with strong kerosene emulsion before planting out.

Insects injurious to gardens, fields, orchards, and forests, A. Lundardoni (*Gli insetti nocivi ai nostri orté, campi, frutteti e boschi. Naples: 1894, vol. II*).—The first volume of this extensive work on economic entomology contained the introduction, general entomology, and the Coleoptera. This volume deals with the Lepidoptera.

Notes on some injurious insects, J. G. Jack (*Trans. Mass. Hort. Soc. 1894, pt. 1, pp. 133–151*).—Notes and descriptive remarks, chiefly compiled, on several of the most injurious insects, such as tent caterpillars, cabbage butterfly, horn fly, locust borer, apple and peach-tree borers, codling moth, curculio, cankerworm, sawflies, rose beetle, and June bug, with remarks on the life histories and approved remedies against them.

Injurious insects, R. H. Price (*Texas Sta. Rpt. 1893, pp. 414, 415*).—Brief notes on a serious attack of the plum curculio in plum and peach orchards, and on weevils injurious to stored grain. Where the stone fruits were sprayed with 3 oz. of London purple to 25 gal. of Bordeaux mixture, 90 per cent of the fruit was saved, against 50 per cent where the trees were untreated.

Report on injurious insects and plant diseases in Norway, 1893, W. M. Schöyen (*Christiania: 1894, pp. 27*).

Phylloxera treatment in Spain, C. L. Adams (*U. S. Consular Rpt. 1894, Nov.,*

pp. 396–398).—A review of the method of combating phylloxera by destroying all vines attacked, disinfecting the ground with carbon bisulphid, and replanting with American stocks. The apparatus and process of injecting the fluid into the ground are described in detail. The Government is aiding in the work of exterminating the insects.

On the destruction of the apple louse (*Wiener ill. Gart. Ztg., 1894, No. 12, pp. 452, 453*).—Directions for the destruction of *Schizoneura lanigera.*

Bisulphid of carbon as an insecticide, J. B. SMITH (*Ent. News, 5 (1894), No. 7, pp. 221, 222*).—Notes on treating the melon louse on muskmelons, by placing an open cup containing a drachm of the chemical at each hill, and covering the plant with a large inverted bowl or wooden box, and leaving for one hour. In nearly every case all the aphides were killed, and the method is recommended.

Experiments with bisulphid of carbon as an insecticide, G. BATTANCHON (*La Vigne Amér., 18 (1894), No. 10, pp. 305–312*).—Experiments with using the chemical against the Phylloxera gave very unfavorable results. It was effective only in exceedingly permeable soils, and there merely temporarily.

The employment of various inorganic chemicals for the destruction of injurious insects, A. BERGÉ (*Ann. Soc. Ent. Belg., 37 (1893), pp. 362–365*).—Enumeration of numerous chemicals useful as insecticides.

Predaceous and parasitic enemies of the Aphides, II, H. C. A. VINE (*Internat. Jour. Micr. and Nat. Sci., 4 (1894), ser. 3, pp. 337–351, pls. 2*).

Bacteria and insect pests, A. C. FORBES (*Gard. Chron., 16 (1894), ser. 3, p. 776*).—An account of the discovery of a bacterium fatal to *Liparis monacha.*

Entomological notes, I. H. ORCUTT and J. M. ALDRICH (*South Dakota Sta. Rpt. 1892, pp. 20, figs. 2*).—A reprint of Bulletin 30 of the station (E. S. R., 4, p. 170).

FOODS—ANIMAL PRODUCTION.

Hay from Norwegian grasses, F. H. WERENSKIOLD and E. SOLBERG (*Tidskr. norske Landbr., 1 (1894), pp. 190–198*).—Analyses are given of 39 samples of timothy hay, 12 of tall meadow fescue, 3 of tall oat grass, 6 of orchard grass, and 5 of meadow foxtail. The samples were grown in different parts of Norway, and were properly identified, pure specimens. The average composition of the various samples was as follows, all results having been calculated on basis of a uniform water content of 15 per cent:

Composition of hay grown in Norway.

	No. of analyses.	Moisture.	Ash.	Sand.	Crude protein.	Crude fiber.	Nitrogen-free extract.
		Per. ct.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Timothy (*Phleum pratense*)	39	15	2.8–6.80	0–0.70	3.3–10.40	18.9–32.90	38.7–56.20
			4.44	0.18	6.35	27.84	46.19
Tall meadow fescue (*Festuca elatior*)	12	15	3.9–7.60	0.1–0.90	3.6–7.60	19.4–33.10	43.6–55.20
			5.50	0.63	5.64	27.27	45.96
Tall oat grass (*Avena elatior*)	3	15	4.5–4.80	0.1–0.40	3.3–4.90	28.9–30.10	45.4–46.90
			4.67	0.23	4.18	29.56	46.36
Orchard grass (*Dactylis glomerata*)	6	15	4.7–7.90	0.1–0.50	4.2–7.80	28.5–35.50	37.2–42.40
			6.55	0.30	5.43	32.05	40.67
Meadow foxtail (*Alopecurus pratensis*)	5	15	3.6–6.50	0.1–0.20	4.3–10.60	28–33.90	37–43.60
			4.65	0.15	7.06	31.81	41.33

The digestibility of the protein compounds was determined by Stutzer's method, with the following results: Timothy (4 samples), 65.8 to 82 per cent; sheep's fescue (3), 70.4 to 80.5 per cent; tall oat grass (1), 85.5 per cent; orchard grass (2), 73.6 to 85.6 per cent; fiorin or creeping bent grass (2), 65.1 to 71.8 per cent; brome grass (1), 77.6 per cent; meadow foxtail (1), 75.8 per cent.—F. W. WOLL.

Analyses of feeding stuffs (*Utah Sta. Rpt. 1893, pp. 254, 255*).—Analyses with reference to food ingredients of corn fodder, corn silage, native hay, mixed tame hay, lucern hay, vetches, wheat straw, red clover hay, and timothy hay; green red clover, alsike clover, meadow fescue, English rye grass, pea-vine clover, burnet grass, orchard grass, brome grass, timothy, white clover, *Galega officinalis*, rescue grass, *Phalaris arundinacea*, and sainfoin; clover silage, potatoes, sugar beets, turnips, and carrots; and corn, barley, wheat bran, corn meal, ground oats, ground wheat, ground rye, and bran and shorts.

Adulteration of cattle food, F. E. EMERY (*North Carolina Sta. Bul. 103, p. 248*).—A sample of wheat bran was found to contain unground kernels of wheat, oats, cockle, chess or cheat, and several other varieties of weed seeds to the amount of 10.96 per cent. Some of the light wheat kernels were filled with a dark powder, supposed to be bunt or stinking smut. The cockle seed amounted to 2.77 per cent, equivalent to 55.4 lbs. per ton of bran. The chess or cheat amounted to 1.01 per cent, or 20.2 lbs. per ton.

The relative value of wheat, peas, corn, and barley, when mixed with bran, in the production of pork, A. A. MILLS (*Utah Sta. Bul. 34, pp. 10*).

Synopsis.—An experiment with 4 lots of 3 pigs each to compare wheat, peas, corn, and barley, when mixed with bran. In about 5 months the lot on peas and bran made the most rapid gain and the largest gain for the food consumed. The wheat mixture came second, followed by corn and barley. Wheat and bran proved the cheapest food. With pork at 4 cts. per pound live weight, 89.4 cts. per bushel was realized for the wheat.

Twelve pure-bred Berkshire boars from 11 to 19 weeks old were divided into 4 lots and fed from December 4 to May 16 as follows: Lot 1, wheat and bran; lot 2, peas and bran; lot 3, corn and bran; and lot 4, barley and bran. The grain and bran were mixed in equal parts by weight. The grain was ground and fed *ad libitum* in the form of slop. The detailed record of the gains and food eaten are tabulated. The summary is as follows:

Summary of experiments with pigs.

From December 6 to May 16.	Lot 1, wheat and bran.	Lot 2, peas and bran.	Lot 3, corn and bran.	Lot 4, barley and bran.
Gain per day per pig .... pounds..	0.69	1.09	0.63	0.56
Food consumed per day per pig .... do....	2.78	3.97	2.85	2.57
Food consumed for 1 lb. of gain, live weight .... do....	4.02	3.63	4.55	4.62
Cost of food for 1 lb. of gain, live weight .... cents..	2.51	3.18	2.84	3.00

The cost of food is based upon the following prices of grain per 100 lbs. ground: Wheat, 75 cts.; peas, $1.25; corn, 75 cts.; barley, 80 cts.; and bran 50 cts. The lot on peas made the largest gain and the best gain for the food consumed, but at the ruling prices the lot on wheat made the cheapest gain. Deducting the cost of the bran and allowing 4 cts. per pound live weight for pork, the following prices per bushel were realized: Wheat, 89.4 cts.; peas, $1.02; corn, 70.4 cts., and barley 59 cts. "One hundred pounds of wheat in the mixture proved to be equal to 88 lbs. of peas, to 118 lbs. of corn, and to 121 lbs. of barley."

Feeding silage vs. dry fodder, J. W. SANBORN (*Utah Sta. Rpt. 1893, pp. 11–20*).—Three lots of 3 yearling steers each were fed from December 21 to March 29 as follows: Lot 1, silage weighted or unweighted; lot 2, corn fodder from the same field, which had been ensiled after drying, and lot 3, dry corn fodder stored in a loft. In addition to these materials grain (not described) and moist hay or straw were fed. The quantity of silage given amounted to about 30 lbs. This is all the animals could be induced to eat, and the food of the other lots was made to conform in dry matter approximately to that fed the silage lot. This, according to the author, explains the fact that during the 3 months the silage lot lost 58 lbs., the lot on ensiled-dried fodder 47 lbs., and the lot on dry corn fodder gained 71 lbs. It is believed that a good growth would have been made had the silage lot been given all the dry food they would eat.

At the conclusion of the experiment the steers were slaughtered, and the weight of the parts and results of analyses of the parts of the carcass are tabulated. The carcass of the silage lot averaged 74.8 per cent of water and 7.65 per cent of fat, as compared with 74.9 per cent of water and 9.31 per cent of fat in case of the lot fed corn fodder. Counting the water in the food, the silage lot consumed considerably more water, although they drank only about half as much as the others. Previous experiments at this station on the above subject have been reported in Bulletin 19 of the station (E. S. R., 4, p. 738).

"This test will prove the last that the writer will undertake at the Experiment Station of Utah on this subject. He has become completely convinced that the process of preservation of food by the silo, in the perfect harvest climate of Utah, is a costly, wasteful, and, in almost every conceivable respect, an undesirable method of food preservation. Corn fodder, or any other kind of fodder, in our climate can be cured to almost ideal perfection."

Feeding roots, J. W. SANBORN (*Utah Sta. Rpt. 1893, pp. 21–23*).—To compare roots with no roots on steers 3 steers were fed mixed hay, corn fodder, grain, and carrots, and 2 other steers received the same materials without roots from March 29 to May 10. The gain per steer was 60.3 lbs. for the lot with roots and 71 lbs. for the lot without roots, and the dry matter eaten per steer daily 15.4 lbs. by the lot on roots and 14.1 lbs. by the lot without roots.

"In all previous trials, covering several years, with various kinds of roots, we have failed to find that a pound of dry matter in roots is more valuable than the ordinary air-dried fodders."

Steer feeding experiment, III, C. C. GEORGESON, F. C. BURTIS, and D. H. OTIS (*Kansas Sta. Bul. 47, pp. 17–31*).

Synopsis.—A comparison of the gains of steers on dry and soaked corn and the gains of pigs following these steers. The steers on soaked corn made a larger gain and ate less corn than those on dry corn, but the pigs following the steers fed dry corn made the larger and more economical gain. The steers on soaked corn voided about 11 per cent of the corn uneaten, and those on whole corn about 16 per cent.

The experiment was with 10 grade Shorthorn steers, 2½ years old, and lasted from November 7 to April 6. After a preliminary trial the steers were divided into 2 lots of equal weight and placed in separate yards with a shed at the north side inclosed on 3 sides. The corn for both lots was shelled, but that for lot 1 was soaked until it began to soften, while that for lot 2 was fed dry. To avoid trouble from the soaked corn freezing the grain was fed 5 times daily to both lots. The amount of corn per lot was increased from 50 lbs. per day at first to 135 lbs., which was changed to 125 lbs., and later reduced to suit the appetite. Both lots received the same coarse fodder, which was at different times corn fodder, oat straw, millet hay, and prairie hay. Eight shoats of an average weight of 88 lbs. per head were placed with each lot and fed what additional corn they required.

The food eaten, gain in weight, and cost of food for the steers are summarized in the table below, no account being taken of the cost of soaking the corn.

Food eaten and gains by steers on dry and soaked corn.

	Food eaten by lot.		Total cost of food.	Gain in weight.		Cost of food per pound of gain.	Food eaten per pound of gain.
	Corn.	Coarse fodder.		Total for lot.	Average per head daily.		
	Pounds.	*Pounds.*		*Pounds.*	*Pounds.*	*Cents.*	*Pounds.*
Lot 1, soaked corn	[1]15,787.5	8,340	$90.61	1,632	2.18	5.55	14.78
Lot 2, dry corn	16,244.5	8,127	92.57	1,468	1.96	6.30	16.60

[1]Dry weight.

"Although lot 2 [dry corn] ate 457 lbs. of corn and 213 lbs. of fodder more than lot 1, they, nevertheless, gained 164 lbs. less than lot 1, and the gain they did make cost three-fourths of a cent per pound more than the gain of lot 1. This difference, I think, can fairly be ascribed to the soaking of the corn fed to lot 1."

The gains made by the pigs were as follows:

Gains made by pigs following steers and additional corn given them.

	Grain in weight.		Extra corn fed to lot.	Cost of extra corn.	
	Total for lot.	Average per head daily.		Total for lot.	Average per pound of gain.
	Pounds.	*Pounds.*	*Pounds.*		*Cents.*
Lot 1, following steers fed soaked corn	635	0.56	1,272	$6.36	1.00
Lot 2, following steers fed dry corn	747	0.66	1,272	6.36	0.85

"The hogs following lot 2 gained 112 lbs. more than those following lot 1 in 141 days. Since they were fed exactly the same amount of extra corn this difference must be ascribed to the difference in feed of the two lots of steers."

From December 23 to January 19 (28 days) the droppings were gathered from both lots of steers and the corn carefully washed out and weighed.

"This revealed the fact that the steers in lot 1 discharged 339 lbs. of corn out of the 3,045 lbs. which they consumed in that period, or 11 per cent of the amount they ate. On the other hand, lot 2 discharged 486 lbs. of the 3,060 lbs. of corn they consumed in the same time, or nearly 16 per cent (15.8 per cent) of the corn fed. Now, applying these ratios for the entire period, we find that the hogs following lot 2 ate 890 lbs. more corn than lot 1, which is amply sufficient to account for the gain of 112 lbs. more than the gain of lot 1."

To observe the time required for corn to pass through the steers red corn was fed one half day. The first appeared about 20 hours later, was at the maximum about 48 hours after feeding, and 2 days later had practically disappeared.

The steers in lot 1 (soaked corn) were sold for 4 cts. per pound and those in lot 2 for 3.75 cts., while the pigs sold for 4.65 cts. At these prices there was a total loss on steers and pigs in lot 1 amounting to $24.30 and in lot 2 to $44.30, "a difference in favor of soaking corn of $20." The pigs following lot 2 gave a profit of 80 cts.

As to the economy of soaking corn for steers the authors conclude that when it is necessary to take the precautions against freezing, which were observed in this experiment, it will not pay, but, "based on the foregoing figures, it will pay to soak corn if it can be soaked for 6 cts. or less a bushel."

Breed tests with cattle, sheep, and hogs, J. W. SANBORN (*Utah Sta. Rpt. 1893, pp. 23–31*).—The object of these trials was to compare the gains of native and bred stock when fed similar kinds of food.

Breed test with cattle.—From December 21 to May 31, 3 native bulls and 1 steer, 1 Devon steer, 2 Shorthorn bulls, and 1 Aberdeen-Angus bull were fed alike, *ad libitum*, on mixed hay, corn fodder, roots, and a mixture of one-half wheat and one-half bran. Some of the animals suffered from scours, so that the comparison is not safe after February 20. Up to this time the natives gained 304 lbs. and the thoroughbreds 188 lbs. The thoroughbreds "consumed a little less per cent of live weight daily than did the natives."

Breed test with pigs.—From December 21 to May 31, 4 native pigs were compared with 4 Berkshires, 3 boars and 1 sow in each lot. The grain feed consisted of bran, ground wheat, and barley, with or without ground peas. The Berkshires gained 183 lbs, and the natives 178 lbs. The food consumed per pound of gain was 5.85 lbs. for the Berkshires and 6.28 for the natives.

Breed trial with sheep.—Three Shropshire ewe lambs were compared with 3 native ewe lambs. "The Shropshires gained in 70 days 3 lbs. less than the natives, or 1 lb. each, the gain being as nearly identical

as it well could be. . . . The natives ate 5 lbs. more food than the other lot."

On cacao as food, H. Cohn (*Ztschr. physiol. Chem., 20, No. 1 and 2, pp. 1–27*).

Report on the extent and character of food and drug adulteration, A. J. Wedderburn (*U. S. Dept. Agr., Division of Chemistry Bul. 41, pp. 64*).—The replies received from a large number of circulars sent to druggists and members of State pharmaceutical and dairy associations, making inquiry as to adulterations, form the basis of this report. These are arranged by States, but no statistics are given showing the extent of adulteration. The bulletin concludes with extracts from articles printed elsewhere relating to food adulteration.

A compilation of the pharmacy and drug laws of the several States and Territories, A. J. Wedderburn (*U. S. Dept. Agr., Division of Chemistry Bul. 42, pp. 152*).—This includes the laws in 45 States and Territories. "There are no laws on this subject in the following States and Territories: Idaho, Indiana, Montana, Nevada, Arizona, and the Indian Territory."

The need for fuller statistics of adulteration, C. H. Cribb (*Analyst, 19 (1894), Dec., pp. 273–279*).

Temperatures injurious to food products in storage and during transportation, and methods of protection from the same, H. E. Williams (*U. S. Dept. Agr., Weather Bureau Bul. 13, pp. 20*).—Information as to the temperature conditions favorable to the safe-keeping of food products in storage, the slaughtering of cattle and hogs with a view to the subsequent preservation and curing of the meat, and suggestions as to how best to utilize the weather reports in connection with the safe storage and shipment of food products. It includes the matter contained in the pamphlet entitled "Protection of fruits, vegetables, and other food products from injury by heat or cold during transportation," issued during the past summer (E. S. R., 6, p. 419).—O. L. FASSIG.

The breeding of cows giving milk rich in fat (*Molk. Ztg., 8 (1894), No. 42, pp. 646–648*).

The winter keeping of milch cows, B. Rost (*Molk. Ztg., 8 (1894), No. 47, pp. 721, 722*).—Popular remarks on the stabling, care, and feeding of cows.

Experiments in feeding Irish potatoes to milch cows, C. Cornevin (*Bul. Min. Agr. France, 13 (1894), No. 6, pp. 539–561*).

Experiments in feeding Irish potatoes to sheep and cattle, A. Girard (*Bul. Min. Agr. France, 13 (1894), No. 6, pp. 498–538*).

Rational stock feeding, F. E. Emery and B. W. Kilgore (*North Carolina Sta. Bul. 106, pp. 279–320*).—This is a popular bulletin on the subject of stock feeding, giving the scientific principles of feeding animals, compilations of analyses of feeding stuffs, coefficients of digestibility, feeding standard, description of the method of calculating rations, the calculation of some rations fed in North Carolina with some suggested changes, comments of practical stock feeders, etc.

Prominent Swedish dairy herds, I–IV, H. Nathorst (*Tidskr. Landtmän, 15 (1894), pp. 702–707, 719–724, 735–740, 753–761, 771–776*).—Descriptions of the system of farming practiced on 4 large Swedish estates, in the management of which modern methods are followed. Yields and composition of milk produced, system of feeding, and similar information are given.

North American swine husbandry, Backhaus (*Nordamerikanische Schweinezucht. Berlin: Deutschen Landwirtschafts-Gesellschaft, 1894, pp. 148, figs. 21*).—This book is the result of Professor Backhaus's visit to this country in 1893 and his study of animal industry at the World's Fair, experiment stations, private farms, and slaughterhouses, as a representative of the German Agricultural Society. His report bears evidence of the thoroughness and intelligence of his work. He describe the breeds, breeding, selection, care and handling, feeding, swine-breeders' associations, promotion of swine breeding by the press and shows, system of recording stock, and the immense slaughterhouses. He concludes that America is undoubtedly

far ahead of any other country in swine breeding, not only in a purely agricultural sense, but in the development of the hog, in the matter of record books, in swine shows, extent and encouragement of swine breeding, and the utilization of swine.

Is in-breeding of farm animals unqualifiedly deleterious and rejectable? E. O. Arenander (*Kgl. Landt. Akad. Handl. Tidskr., 33 (1894), pp. 217–239*).—Answered in the negative; a historical sketch of the practices of breeding adopted by eminent breeders as Bakewell, Colling, Booth, Webb, Fink, etc., are included in the paper.

Live stock and poultry at Calhoun, Louisiana, J. G. Lee, (*Louisiana Stas. Bul. 29, 2d ser., pp. 1010–1014*).—Brief notes on the cattle, sheep, and hogs grown at the station and a record of eggs laid by hens of different breeds.

VETERINARY SCIENCE AND PRACTICE.

The diagnostic value of tuberculin, Bang (*Paper read at Eighth International Congress of Hygiene (1894); abs. in Ztschr. Fleisch- und Milchhyg., 5 (1894), p. 2*).—Of 207 animals which gave a well-marked tuberculin reaction, and on which the autopsy was properly performed, the author found 96 per cent tuberculous. To fatten and slaughter all animals which react appears to him not feasible, for in some herds 80 per cent are diseased. He recommends that those which manifest no signs of disease be simply separated from the rest of the herd and used as before, even for breeding purposes. Calves must be taken from the infected stables immediately after birth.

In infected calves tuberculosis was, in the majority of cases, traceable to infected milk. Unboiled milk should not be fed to calves excepting the colostral milk on the first day. This might be heated to 65° C., to reduce the virulence of the tubercle bacilli.

The author illustrates this mode of suppression with a striking example. Two years ago a herd of 208 head of cattle showed upon the injection of tuberculin, 80 per cent of the cows, 40 per cent of the steers, and 40 per cent of the calves infected. The stable was thereupon thoroughly disinfected and divided into two stables by means of a board partition. After removal of those animals which showed distinct signs of the disease the healthy and the presumably infected (those which appeared still healthy) were kept separated and taken care of by different persons. The calves of the infected cows were removed immediately after birth, fed with boiled milk, and tested a few weeks later. None of these has thus far given a reaction.

The whole herd was retested twice a year. In the first year after the segregation 10 per cent of the presumably healthy gave a positive reaction with tuberculin. After this second weeding out only 1 out of 107 gave a reaction, and this spring (1894) only 2 out of 122. None of the calves of diseased cows has shown any disease.

This the author regards as the most natural and cheapest method of eradicating tuberculosis.

This experiment was made at Government expense. Denmark passed a law in 1893 granting for 5 years a yearly sum of 80,000 crowns.

Young animals are tested entirely at Government expense. For older animals a small sum is exacted. The author who has charge of this work selects, by preference, dairies of medium size.

Thus far 327 farms have been inspected. Of 8,401 animals tested 3,362 (or 40 per cent) have reacted. In this inspection marked differences in the distribution of the disease have been found. Those herds subject to a continual change of animals are most seriously infected. Smaller herds may be entirely free from the disease. Of such the author has found 52, consisting of from 10 to 42 cows each.—T. SMITH.

Tuberculosis and swine plague, OLT (*Ztschr. Fleisch- und Milchhyg., 5 (1894), p. 6*).—The author briefly reviews the difficulty encountered in differentiating tuberculosis from swine plague. After making a histological examination of a number of cases he comes to the conclusion that swine plague is rare while tuberculosis is quite frequent. Swine plague is limited to the lungs, while tuberculosis is usually found generalized over the entire body. Large cheesy masses in the lungs with adhesions to the chest wall and diaphragm, but without caseation of the bronchial glands or invasion of other organs, may be safely regarded as swine plague.—T. SMITH.

Experiments regarding the application of tuberculin for the diagnosis of bovine tuberculosis, H. SAWELA (*Mustiala Agl. College Rpt. 1892, pp. 113–140*).—Tuberculosis having been discovered in the Mustiala College herd the cattle were killed and tuberculin tests made previous to slaughtering. Forty-seven animals out of 51 inoculated showed an increase in temperature after the injection, the increase in 41 cases amounting to 0.5° C. (0.9° F.) or more. Of this latter number 34 animals proved tuberculous in the *post-mortem* examinations; the result was uncertain in 4 cases, and 3 were free from the disease. Of the 10 cases where no reaction was obtained, 6 were found healthy and 4 tuberculous. Excluding the uncertain cases the tuberculin test gave reliable results for 78.4 per cent of the animals; if these are included the tuberculin gave correct results in 86.3 per cent of the cases.

Tuberculin tests were also made on 7 different farms. Of 71 cows injected 20 gave reactions; of those reacting all but 1 animal were found in a single herd.—F. W. WOLL.

On tuberculin, O. MALM (*Bio. Path. Lab. Christiania Rpt. 1891–'93, 1, pp. 11–104*).—The paper forms a monograph of the subject and gives a historical sketch of tuberculin, its action on man, use as a diagnostic agent for tuberculosis, original investigations with farm animals, the making of tuberculin, and its chemical nature.

The author's discussions are based largely on original work. If tuberculin is injected directly into the blood the rise in temperature is more rapid and of shorter duration than if injected hypodermically; if given through the mouth, the agent is without any effect. While possessing no power of bringing immunity, the author states that it may, when applied in very small gradually increasing doses, be successfully used as a curative remedy with certain forms of consumption.

Especially in the early stages of the disease tuberculin is an almost infallible diagnostic agent. Its application to cattle in doses of ½ grain, injected hypodermically, is harmless; only in very advanced cases, and with greatly weakened animals, may it call forth dangerous poisoning. A decrease of temperature followed by death in advanced cases is often noticed.

When kept in the dark tuberculin will keep for a long time, if undiluted; when diluted it is easily decomposed. Its toxic effect can not at present be accurately determined. Tuberculin prepared from tuberculous hogs or horses possesses as toxic and characteristic properties as that prepared from human tuberculosis. Tuberculin prepared from bird tuberculosis, on the other hand, has much weaker effect.

The author reports the results of injections made with 326 head of cattle and swine; 6 calves and 13 hogs were included in this number. Forty-four head of cattle and 1 hog were killed; 32 animals reacted, of which number 28 were found tuberculous, and 4 were free from tuberculosis. Twelve animals free from tuberculosis gave no reaction, and the tuberculous cattle reacted in every case.

The monograph contains a résumé of the contents in French, and is accompanied by a very complete bibliography of the subject.—F. W. WOLL.

Contagious diarrhea of calves, F. ULRICHS (*Deut. landw. Presse, 21 (1894), No. 95, p. 886*).—The author takes the position that the trouble results from infection of the umbilical cord of new-born calves. Hence he recommends the use of coal tar and carbolic acid on the navel as a disinfectant.

On tuberculosis in farm animals, H. NATHORST (*Tidskr. Landtmän, 15 (1894), pp. 810–814, 843–848*).

DAIRYING.

Abnormal milk, R. G. SMITH (*Jour. Soc. Chem. Ind., 13 (1894), No. 6, pp. 613, 614*).—A sample of milk was examined which, when creamed, was churned by merely stirring it for 1 or 2 minutes with a stick. The ripened cream was semisolid and contained 57.4 per cent of fat. The cream rose quickly and formed a very compact yellow layer. The composition of the milk was as follows:

	Per cent.
Water	84.000
Fat	7.500
Solids-not-fat	8.500
Sugar (by difference)	4.290
Protein	3.540
Ash	.670
Specific gravity	1.027

An analysis of the ash indicated that there might be a deficiency in one or all of the potassium compounds and an excess of one of the lime salts, "probably dicalcic phosphate, which might be there to the exclusion of much of the tricalcic form." The butter had a pleasant taste and was similar in every respect to butter made in the ordinary way. Its composition was as follows:

	Per cent.
Water	15.28
Fat	83.32
Curd, etc	1.39
Salt	.01
	100.00

The volatile fatty acids by the Reichert-Meissl-Wollny method were 28.4 per cent.

A milk behaving similar to the above, which was produced by a Shorthorn cow in another locality, had the following composition:

	Per cent.
Water	86.2900
Fat	4.3500
Solids not fat	9.3600
Sugar (by difference)	5.1300
Protein	3.5100
Ash	.7200
Specific gravity	1.0324

Microscopic examination of the first sample showed "that the fat globules in this abnormal milk are very large, practically double the diameter, that is, eight times the size of those in the milk of our Jersey breed, which is admitted to have the largest. The mean diameter of the globules in the Edingham milk was less than the Belford sample, having an average of 0.0003 in. The surface tension of the suspended fat globules in both milks was very low, pressure on the cover glass being sufficient to make them lose their apparently circular shape and run together with great readiness." In all probability the size of the fat globules explains the abnormality.

Subsequently a number of other cows were heard of whose milk showed similar abnormality.

Annual Report of Oerebro Chemical and Seed-Control Station for 1893, J. WIDEN (*Oerebro* (*Sweden*), *1894*, *pp. 43*).—The report gives a summary of the work done during 1893. The chemical station analyzed 3,394 samples in all, 2,158 of which were of milk and dairy products and 898 to be examined for arsenic. The detailed results of the analyses are given in the report. The new milk examined contained, on an average, the following percentages of fat during the various months of the year:

Composition of whole milk.

Month.	Number of samples.	Highest.	Lowest.	Average.	Month.	Number of samples.	Highest.	Lowest.	Average.
		Per ct.	*Per ct.*	*Per ct.*			*Per ct.*	*Per ct.*	*Per ct.*
January	100	4.20	2.15	3.17	September	116	5.00	1.80	3.59
February	193	4.10	1.80	3.16	October	57	5.00	2.70	3.65
March	298	4.25	1.80	3.44	November	273	5.00	2.30	3.49
April	62	4.00	2.25	3.10	December	175	4.20	2.20	3.31
May	146	4.40	1.95	3.11					
June	134	4.20	2.10	3,14	Total and average.	1,835	5.00	1.80	3.32
July	167	4.35	2.15	3.29					
August	114	4.90	2.35	3.33					

Seventy-nine samples of creamery butter and 23 samples of farm butter were analyzed during the year; the average composition of both classes of butter, with extremes, was as follows:

Composition of farm and creamery butter.

	Water.	Fat.	Casein.	Milk sugar, lactic acid, and ash, less salt.	Salt.
Creamery butter (export butter):	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Average	14.70	80.97	0.69	1.53	2.41
Highest	19.35	84.49	.94	3.31	3.80
Lowest	12.32	76.64	.55	.90	.42
Farm butter:					
Average	14.70	80.05	.58	1.69	2.31
Highest	18.92	85.18	.80	3.42	3.50
Lowest	9.95	74.66	.42	.72	.50

The author states that the per cent of water in the butter seems dependent on whether water or skim milk is used for washing the butter in taking it out of the churn. Eight samples washed with water contained from 14.62 to 16.87 per cent of water, with an average of 15.42, while 6 samples treated with some skim milk at the end of the churning contained from 13.86 to 15.92 per cent of water, with an average of 14.51, or nearly 1 per cent less where skim milk was used.—F. W. WOLL.

The loss of total solids in milk on keeping, E. J. BEVAN (*Analyst, 19 (1894), Nov., pp. 241–250*).—Samples of milk which were weighed out in platinum dishes and placed in desiccators until the following morning before evaporating were found to differ in total solids from the calculated results by about 1 per cent. Experiments were then made in evaporating samples of milk at once and after standing 24, 48, and 120 hours, which showed that there was a considerable decrease in the percentage of total solids, amounting to 0.94 after 24 hours and to 2.31 per cent after 120 hours. The author has found that lactic acid is volatile. When 0.1445 gm. of pure lactic acid was added to 5 gm. of fresh milk the solids obtained amounted to 0.6610 gm., as against 0.5784 gm. in the original milk, corresponding to a loss of 42.8 per cent of the lactic acid added. When the samples were neutralized the loss in total solids in keeping was considerable less than when not neutralized. There was found to be "absolutely no connection between the loss and the percentage of acid formed." The impossibility of accurately compensating for the loss of solids in samples of milk partly decomposed, as is now practiced by the Government chemist, is insisted upon.

In the discussion following Mr. Richmond said that in a series of experiments which he had made some years since he had found that lactic acid, especially in concentrated solution, was distinctly volatile when distilled with water. From Mr. Bevan's figures it appeared, roughly speaking, that the greater the amount of acid formed the less the loss of total solids, a fact which his own experience confirmed. In

one sample which had been kept for 6 or 7 weeks there was a loss of 5 to 6 per cent of the total solids, although only a small amount of acid had been formed.

Dr. Frankland's researches, he said, indicated very strongly that in keeping milk in a bottle there was likely to be considerable difference in the products of decomposition, according as the bottle was tightly corked or the reverse. The products of the decomposition of milk were so varied that it was impossible to fix any time allowance. The determination of calculations back of the alcohol and other bodies formed seemed to be of doubtful accuracy. He had found in the case of koumiss that it was possible to find an approximately constant factor for this, though hardly accurate enough for analytical purposes.

Mr. Allen reported some trials in which samples of milk were placed in tubes hermetically sealed, one tube being opened each week. Other samples were diluted with hydrant water and canal water and kept in a similar way. The solids in the case of undiluted milk fell in 52 days from 12.58 to 11.21 per cent, a loss of 1.37 per cent. The diluted milks lost in the same time 1.44 and 1.46 per cent, respectively. Mr. Cassal had noticed considerable diminution in the total solids on keeping milk. There was no regularity about it, and he believed it was unscientific and absurd to suppose there should be. The extent of the loss would depend upon the temperature at which the samples were kept and on the nature of the organisms which had obtained access to the milk.

Mr. Yarrow had noticed a great loss in milk solids when the samples were not evaporated as rapidly as possible. When there was a delay in evaporation the loss amounted sometimes to as much as 2 per cent.

The use of formic aldehyde for preserving milk for analytical purposes was mentioned, and several analysts stated that they had employed it successfully for some time past. In one case it was stated that 0.05 per cent would keep milk for a month and large quantities almost indefinitely. Another analyst has found that the addition of 5 or 6 drops was sufficient to preserve a sample for a week. In Mr. Stokes's laboratory one sample to which a 40 per cent solution of formic aldehyde had been added was apparently fresh after keeping 9 months, although there had been a loss of 0.4 per cent in the total solids and 0.2 per cent in the fat. Some experiments were announced as in progress which were intended to show the rate of decomposition in milk when this preservative was added.

Test of mechanical methods for determining milk fat by the German Dairy Association (*Milch Ztg., 23 (1894), No. 46, p. 737*).— It will be remembered in the first test the judges found none of the methods submitted satisfactory. In the second test for the prize of 3,000 marks ($750) the judges reported that none of the methods entered fulfilled the requirements under which the prize was offered; that is, gave results without the use of a chemical balance, which were as accurate as the results of volumetric determinations. Although

these requirements were not fulfilled the judges regarded the methods of A. H. L. Horn, Gerber, Krugmann, and Lindström as about equally accurate and of value for the use of the farmer. They recommend that each be awarded 500 marks. The detailed results of the tests of the methods are promised later.

Pasteurization of cream, H. APPEL (*Mälkeritid., 7 (1894), p. 428*).—At the Randers (Denmark) Agricultural Fair in June, 1894, 250 entries of butter were made, 120 of which were made from pasteurized cream, and 130 from unpasteurized cream. Of the butter made from pasteurized cream 32.5 per cent was awarded premiums, as compared with 5.4 per cent of butter made from non-pasteurized cream.—F. W. WOLL.

Dairy calendar for 1895, F. W. WOLL (*New York: John Wiley & Sons, 1895, pp. 327*).—This little book is on the plan of the German agricultural calendars, but is even more comprehensive and practical. One-half consists of a diary, and the remainder of condensed information on breeds, milk, cream, butter, cheese, feeding, general tables, statistics, and a directory of dairy associations, commissioners, schools, institutes, etc. As a reference book for dairymen, butter and cheese makers it deserves commendation. It is to be welcomed as a valuable addition to our rapidly growing literature of practical dairying.

Effect of certain plants on the quality and the odor of milk, J. AUZAT (*Ind. Lait., 19 (1894), No. 39, p. 311*).

Milking two or three times a day, A. SCHMEKEL (*Ill. landw. Ztg.; abs. in Orgaan Ver. Oudleerlingen Rijks Landbouwschool., 7 (1894), No. 77, p. 90*).

Increased yield of butter fat in creaming by continued cooling with water, H. PUCHNER (*Ztschr. landw. Ver. Bayern, 1894, June, pp. 480–484*).

The souring of cream, BOLSOM (*Ind. Lait., 19 (1894), No. 40, pp. 318, 319*).

Dairying in Siberia, J. BETZ (*Molk. Ztg., 8 (1894), No. 46, pp. 705, 706*).

Swedish butter exhibitions (*Tidskr. Landtmän, 15 (1894), pp. 786, 787; 821, 822*).—Accounts of the thirteenth and fourteenth exhibitions at Gothenburg and the twenty-seventh at Malmö.

AGRICULTURAL ENGINEERING.

Frequency of irrigation, J. W. SANBORN (*Utah Sta. Rpt. 1893, pp. 86–94*).—This is an account of a continuation in 1893 of experiments described in the Annual Report of the station for 1892 (E. S. R., 4, p. 87). Plats of wheat, timothy, and clover on gravelly upper bench soil were irrigated at intervals of 3, 6, 9, 12, 15, and 18 days, the total amount of water applied to each plat during the season being the same. In experiments on wheat during 4 years the best average results were obtained by irrigating every 9 days. Timothy did not appear to require so frequent irrigation. For clover irrigation every 16 days gave the best results.

Observations on the temperature of the soil of the different plats before irrigating, 2 hours after, and 1 day after indicated that the less frequent the application of water the higher the temperature of the soil (the difference amounting in some cases to about 10° F.).

Subirrigation vs. surface irrigation, E. S. RICHMAN (*Utah. Sta.

Rpt. 1893, pp. 177–179).—In continuation of experiments briefly reported in Bulletin 26 of the station (E. S. R., 5, p. 690), 1 row of 16 grapevines was subjected to surface irrigation and another, containing 17 vines, to subirrigation. For the latter purpose a wooden tube, 4 in. square inside, was laid in a trench 1 ft. below the surface and 1 ft. from the vines. Water was supplied to the roots of each vine by 2 three-fourths inch holes bored in the tube opposite the vines and protected from dirt on the top and sides by boxing in. In irrigating the pipes were kept filled with water until the ground began to show the effects on the surface. This usually took from 1 to 2 hours.

"So far as the production of fruit is concerned the results are favorable to subirrigation. The yield for 1892 was 36¾ lbs. for the 16 vines under surface irrigation and 39¼ lbs. for the 17 vines under subirrigation, there being no effect noticeable. The yield for 1893 was 53¾ or 3.36 lbs. per vine for the surface irrigation, and 76¾ or 4.52 lbs. per vine for the subirrigated portion."

Determinations of the water content of the soil before irrigation and 30 and 54 hours after irrigation directly over the tubing, and 1, 2, 3, and 4 ft. from the tubing showed that at a distance of 2 ft. from the tubing the water content was but slightly increased and at distances of 3 and 4 ft. it was not affected.

An attempt to substitute V-shaped troughs made of 6-inch boards, placed bottom side up in the trench, was not successful on account of the filling of the drain at the lower end with dirt.

Fall vs. spring irrigation, J. W. SANBORN (*Utah Sta. Rept. 1893, pp. 98, 99*).—Experiments in this line described in the Annual Report of the station for 1892 (E. S. R., 4, p. 87) were continued in 1893. The average for 3 years' experiments on upper bench soil shows an increase of over 22 per cent for fall application in addition to spring application of water.

Night vs. day irrigation, J. W. SANBORN (*Utah Sta. Rpt. 1892, pp. 99–103*).—This is an account of experiments in continuation of those reported in Bulletin 21 of the station (E. S. R., 4, p. 824). The results with wheat show that "there was practically no difference in the grain return, but that an increase of nearly 20 per cent was made in straw in favor of night irrigation." This is probably due, as already suggested, "to the check given the vegetative processes by irrigation, by reducing temperature, resulting, as often occurs, in an increased proportion of grain to straw." The results obtained with grass were exactly the reverse of those obtained with wheat. In order to ascertain the cause of this difference observations were made on the temperature of the air and the moisture content of the soil under the different systems of irrigation, but the data thus obtained were not sufficiently definite to admit of conclusions.

Irrigation, L. FOSTER and C. A. DUNCAN (*South Dakota Sta. Rpt. 1892, pp. 35, figs. 5*).—A reprint of Bulletin 28 of the station (E. S. R., 3, p. 890).

Sewage irrigation, H. S. ORME (*Amer. Fert., 1 (1894), No. 5, pp. 278–280*).—Sewage irrigation in foreign countries is referred to and the practice is recommended for

American cities. Los Angeles, California, is successfully utilizing its sewage in this way.

Irrigation by electricity (*Irrigation Age, 7 (1894), No. 5, p. 228*).—A plan for applying electricity in pumping water is outlined.

Irrigation principles, W. H. HALL (*Irrigation Age, 7 (1894), No. 5, pp. 221-224*).—Discusses water rights.

Road improvement, R. STONE (*U. S. Dept. Agr., Office of Road Inquiry Circular 14, pp. 15*).—This includes text of 3 addresses delivered on this subject.

The use of electricity on a large Italian farm, L. PETRI (*Jour. Agr. Prat., 58 (1894), No. 50, pp. 865-867*).

STATISTICS.

Report of the statistician (*U. S. Dept. Agr., Division of Statistics Rpt. 120, n. ser., 1894, Oct., pp. 607-660*).—The following subjects are treated: Crop report for October; notes from reports of State agents; average yield per acre of wheat, rye, oats, and barley for the different States in 1894; rice production in the United States; notes on foreign agriculture, and transportation rates.

Report of the statistician (*U. S. Dept. Agr., Division of Statistics Rpt. 121., n. ser., 1894, Nov., pp. 663-702*).—The following subjects are treated: Crop report for November; notes from reports of State agents; tabulated data showing the yield per acre of corn, potatoes, sweet potatoes, tobacco, hay, buckwheat, cotton, and sorghum for the different States in 1894; notes on foreign agriculture, and transportation rates.

Report of the results for 1893 of the North Louisiana Station (*Louisiana Stas. Bul. 29, 2d ser., pp. 1009-1048*).—A brief review of the work of the year; remarks on the live stock at the station; record of eggs laid by different breeds of fowls; descriptions of some experiments with field crops, and meteorological observations mentioned elsewhere.

Miscellaneous agricultural topics (*North Carolina Sta. Bul. 103, pp. 239-260*).—This consists of matter of a popular nature reprinted from the press bulletins of January to June, 1894.

Annual Report of North Dakota Station for 1893 (*North Dakota Sta. Rpt. 1893, p. 21*).—A brief general report by the director and the treasurer's report for the fiscal year ending June 30, 1893.

Annual Report of Oregon Station for 1891 (*Oregon Sta. Rpt. 1891, pp. 4, 21-27*).—A brief review of the work of the year, rules prescribed for the station staff, functions and duties of the station council, list of bulletins published by the station, and the treasurer's report for the fiscal year ending June 30, 1891.

Annual Report of Oregon Station for 1892 (*Oregon Sta. Rpt. 1892, pp. 25-44*).—A brief review of the work of the year, the condition of the station, and the treasurer's report for the fiscal year ending June 30, 1892.

Annual Report of South Dakota Station for 1892 (*South Dakota Sta. Rpt. 1892, pp. 217, figs. 7*).—This includes brief reports by the director, agriculturist, chemist, horticulturist, botanist, entomologist, and department of dairy science; the treasurer's report for the fiscal year ending June 30, 1892, and reprints of bulletins 26-31 published by the station during the year.

Annual Report of Texas Station for 1893 (*Texas Sta. Rpt. 1893, pp. 357-435*).—Reports by the director, chemist, veterinarian, horticulturist, and meteorologist, with answers to correspondents; the treasurer's report for the fiscal year ending June 30, 1893; the text of the Hatch act and rulings; list of publications of the station since receiving the benefit of the Hatch act, and a general index to the Annual Report and bulletins of the year.

Reports of director and of treasurer of Utah Station, 1893 (*Utah Sta. Rpt. 1893, pp. 3-10*).—A brief review of the work of the year, list and summaries of bulletins issued, and a financial statement for the fiscal year ending June 30, 1893.

Annual Report of Virginia Station for 1893 (*Virginia Sta. Rpt. 1893, pp. 14*).—Brief reports on the work of the year by the director and heads of the departments, and the treasurer's report for the fiscal year ending June 30, 1893.

Annual Report of Washington Station for 1893 (*Washington Sta. Rpt. 1893, pp. 13*).—Brief reports on the work of the year by the director and heads of the departments, and the treasurer's report for the fiscal year ending June 30, 1893.

Agricultural schools of Belgium, L. DE BRUYN (*Situation de l'enseignement vétérinaire et agricole, pp. 9–246*).—This is an elaborate report from the Minister of Agriculture.

Progress in agricultural education in Germany during the last twenty-five years, A. THAER (*Deut. landw. Presse, 21 (1894), No. 98, pp. 8, 9*).

NOTES.

Georgia Station.—The station has just completed a comprehensive system of surface drainage and sewerage whereby a large portion of the surplus surface water that is precipitated on the farm, together with all sewage matters, are carried beyond the farm limits.

Illinois University and Station.—E. Davenport, M. S., a graduate of the Michigan Agricultural College and for a time professor of agriculture in that institution, has been elected dean and professor of agriculture in the College of Agriculture of the University and agriculturist of the station and member of its board of direction.

Missouri College and Station.—Dr. E. D. Porter, dean of the college and director of the station, died January 5.

New Hampshire College and Station.—H. E. Alvord has been appointed professor of agriculture and agriculturist to the station. R. S. Alden, B. S., has been appointed farm superintendent.

Kentucky Station.—On page 314 of this volume the paper on "The codling moth and apple rot," wrongly ascribed to C. W. Mathews, should be credited to H. Garman.

North Dakota College.—The college has established winter courses of 12 weeks in dairying, agriculture, and domestic economy.

Oklahoma College and Station.—H. E. Alvord has resigned, and E. D. Murdaugh has been elected president of the college.

Pennsylvania College.—Arrangements have been made to include in the creamery course the present winter instruction in pasteurizing milk and cream, and the services of C. L. Beach, of Wisconsin, have been secured as instructor in this branch.

Texas Station.—Beginning with the new year this station has established a new substation near Beeville, Bee County, in extreme southern Texas, to be supported by State appropriation. Citizens have donated 151 acres for this purpose, and building will begin at once. The line of experiments will include soil tests, varietal work with fruits, field crops, and vegetables, and much work undertaken will be of subtropical nature. Irrigation by windmill from underground flow at a depth of 40 ft. will be tried.

Diseases of Plants.—The Royal Botanical Society of Belgium has appointed a committee of research and of reference, in order to supply cultivators with information relating to the various maladies which infest plants. Botanical specimens may be sent to Messrs. Marchal and Nypels, of Brussels; Gravis and Michiels, of Liege, and Laurent, of Gembloux, and insects may be sent to M. Lameere, Brussels, or M. Paskin, Gembloux.

Personal Mention.—Dr. S. Nawaschin has been chosen professor of botany and director of the botanical gardens at the University of Kiew, Russia.

Sappin-Trouffy has been awarded the Desmazières prize of the Botanical Society of France for his work on the structure and development of the *Uredineæ*.

P. Duchartre, the last of the founders of the Botanical Society of France, died at Paris November 5, 1894, at the age of 83 years.

Dr. Buerstenbinder, general secretary of the Agricultural Central Association of the Duchy of Brunswick, Germany, died November 20.

EXPERIMENT STATION RECORD.

VOL. VI. No. 7.

The desirability of more systematic and thorough feeding experiments has at different times been urged in the Experiment Station Record. Many useful experiments in this line have already been made at our stations. We have not, however, fully realized as yet that in order to attain the highest success coöperative experiments involving many animals and requiring the services of a large number of experts should be conducted. Such experiments are costly, but their importance easily justifies large expense on their account. Denmark's success in dairying commands the admiration of the agricultural world. In the following pages Prof. F. W. Woll, of the Wisconsin Experiment Station, has at our request shown in part why Denmark has attained such phenomenal results with her milch cows.

With an area of only 14,500 square miles and a population of something over 2,000,000 people, Denmark at the present receives every year more than $25,000,000 from abroad for her butter product, and in the course of the last 10 years her exports of butter have more than trebled. To trace the causes of such magnificent results is one of the most interesting and profitable tasks that the student of dairying can desire. A very important factor in this progress is doubtless to be found in the work of the Danish State Experiment Station, one branch of whose work we shall briefly consider in this article.

Systematic coöperative experiments along this line of dairying have been conducted in Denmark for more than 20 years past, the first experiments having been made in 1872. The late well-known investigator of dairy problems, Prof. N. J. Fjord, was the originator and the soul of the movement until his death in 1891, since which time the experiments have been continued according to the same plan and in all essential points in the same manner as before under the direction of his successor, F. Friis, a prominent dairyman and estate owner, and for many years a coöperator in Fjord's experiments. The feeding experiments gradually developed into mammoth undertakings, and stand to-day with hardly a parallel in any country, both as regards the extensive scale on which they are carried on and the care in even minutest details expended in their conduct.

The earlier coöperative experiments conducted by Professor Fjord include investigations of such dairy problems as the use of low-pressure boilers for creamery work, storage of ice and snow, conditions affecting the shrinkage of ice in ice houses, creaming of milk, comparative value of centrifugal and gravity creaming, experiments in the manufacture of skim-milk cheese, the cooling of butter, the construction of Fjord's "control centrifuge," etc. These investigations were conducted in creameries and private dairies in different sections of Denmark, as a rule in 3 or 4 different factories at a time, but occasionally, as in the case of the experiments on the relative value of centrifugal and gravity creaming, in as many as 16 different places.

The larger number of these experiments were conducted previous to 1883, and are described in the first 24 reports on dairy experiments conducted by Professor Fjord. The Danish State experiment station was organized as a separate institution in 1883 by the establishment of the central station or the laboratory for agricultural economic experiments of the Royal Agricultural and Veterinary College. The Government appropriated 122,000 kroner ($33,000) for a building in 1882, and a substantial and commodious structure was erected during the following year on the grounds of the agricultural college in Copenhagen. The annual budget of the station has been about $16,500.

The first feeding experiments were begun in the winter of 1883–'84 with an investigation of the value of centrifugal skim milk for calves and pigs. These were followed by experiments as to the comparative value of grain, skim milk, and whey for swine, conducted in 1884–'87 on 9 different estates with 487 animals in all. While the swine-feeding experiments have been continued of late years, the main attention of the station has since 1887 been directed toward the coöperative feeding experiments with milch cows.

These experiments have since 1890 been conducted on 7 or 8 dairy farms in different parts of Denmark under the immediate direction and supervision of the experiment station in Copenhagen. The owners of the estates, who are progressive and public-spirited dairymen, gratuitously place a portion of their herds at the disposal of the station for experimental purposes. The plan of the experiments and the questions to be taken up for study are decided upon by the director of the station after a thorough discussion and consultation with the owners of the estates or their representatives and others interested. The problems investigated have always been of direct practical importance to Danish dairymen, while the experiments have been planned and conducted in a strictly scientific manner and errors guarded against in every possible way, so that the results obtained could be depended upon as absolutely correct. Since 1891 the study of each problem investigated has been continued 2 years without a change of plan, no results being published before the second year's experiment is over. This precaution has, however, been proven rather unnecessary by the results

now at hand, but it unquestionably adds to the value of the experiments.

Each experiment is divided into a preliminary period, the experiment proper, and a post-experimental period.

The preliminary period generally lasts from 3 to 5 weeks. The animals are in each case selected from herds of 100 to 200 milch cows, and are healthy, fresh cows of any age above 2 years. A somewhat larger number of cows than is strictly needed for the experiment is set apart at each estate. These are weighed and their age, time of calving, and milk yield noted. From this number the cows desired for the experiment are selected, either 30 or 40 being generally chosen at each estate. These cows are then put on a uniform ration, and the morning's and evening's milk of each cow weighed and tested by the control centrifuge and by Soxhlet's aërometric method. After some days the cows are separated into lots of 10 each, in such a manner that the average age, live weight, number of days in milk, yield of milk and per cent of fat in the milk of the cows in each lot at each estate are so nearly alike that it may be safely assumed that when fed on the same food they will continue to give approximately the same quantity of milk of similar quality for the greater portion of the period of lactation. The daily weighings and examinations of the milk are now continued for some time as before, and in addition the mixed milk from each lot is analyzed. If the lots thus formed do not prove to fill the demands made, a second grouping of the cows is made, and the feeding and examinations continued until it is found that the lots formed meet the requirements. During an intermediate period of 10 days the animals in the different lots are then gradually accustomed to the food they are to receive in the experiment proper.

During the experiment proper, one lot of cows is fed as in the preliminary and the post-experimental periods, while the rations of the other lots are changed so as to make the former lot intermediate between them. To illustrate: In the fourth and fifth years' experiments barley and oats were compared with mixtures of oil cakes. If 4 lbs. each of grain and oil cakes were fed on a certain estate to lot B (intermediate lot), lot A received 6 lbs. of grain and 2 lbs. of oil cakes, and lot C 2 lbs. of grain and 6 lbs. of oil cakes. The other part of the rations is the same in all cases, except the quantity of straw, this being always fed *ad libitum*.

The different dairymen coöperating are left some latitude as regards the quantity of feeding stuffs to be fed their cows, but the relative proportions of each and the character of the feeding stuffs or rations to be compared is the same in case of all herds.

The experiment proper includes from 4 to 10 10 day periods at the different estates and during different years, the duration of the experiment depending on a variety of causes, the decrease in milk yields of the cows, the supply of feeding stuffs on hand, etc. The experiment

proper is followed by an intermediate feeding of 10 days and a post-experimental period lasting from 40 to 80 days, introduced to study the residuary effects of the rations fed in the preceding period on the production of milk and its components. During this time the cows in all 3 (or 4) lots again receive the same food that was fed to all the cows during the preliminary period, and to one of the lots throughout the experiment. The milk is weighed and analyzed as during the other periods.

The animals included in the experiments at each estate are in charge of a feed master or superintendent paid by the experiment station, whose only business on the estate is to feed and take care of the cows, and to conduct the experiment according to directions. He weighs the morning and evening milk of each cow and also, as a check, the mixed milk from each lot. He furthermore samples the milk, makes examinations by Fjord's centrifuge, weighs out the rations for each lot and distributes among the cows according to the requirements of each animal. He is superintended by an assistant of the experiment station, who visits the estate at intervals and is present regularly on several days during each 10-day period of the experiment proper to make fat determinations according to Soxhlet's method, when such are made, and to perform other work that can not safely be intrusted to the feed master, such as sampling of the mixed milk of the different lots and of feeding stuffs eaten, analyses of which are made in the chemical laboratory of the station. The assistant also sees to it that the experiment is being conducted according to the plan laid down.

Each assistant has the supervision of the experiments at two estates. The series of experiments conducted every year have therefore as a rule required for their management 8 feed masters, 4 assistants, and 4 chemists, besides the chief chemist of the station. The data obtained are recorded and tabulated by the station bookkeeper and clerk, and the director of the station brings the results and the statement of the experiments before the public, making in all 19 men whose time is largely, and as far as 16 men go entirely, taken up with the experiments when these are in progress.

The following synopses of the earlier coöperative feeding experiments will show the main results obtained.

The first year's experiments made (1887–'88) were a study of the value of adding roots to rations containing a good supply of concentrated feeding stuffs. The experiments were conducted on 5 estates, with 146 cows in all. While the average quality of the milk produced remained the same for all lots, the milk yield was increased on the root feeding, viz, nearly 3 lbs. per head per day on ruta-bagas and 1½ lbs. on turnips, feeding 40 lbs. of the former and 26.4 lbs. of the latter. The average live weights of all lots increased during the experiment, the lots receiving roots gaining more than the lot receiving no roots.

The second year's experiments (1889) were a comparison of concentrated feeding stuffs and roots. The concentrated feeding stuffs in the rations were partially replaced by roots in the proportion of 1:10 (ruta-bagas) and 1:12½ (turnips). Forty-four pounds of ruta-bagas or 52.8 lbs. of turnips were also fed to other lots in addition to the regular grain ration. Five estates coöperated, with 186 cows in all. The results showed that 10 lbs. of ruta-bagas or 12 lbs. of turnips were of approximately equal value in the rations fed, both as regards the yield of milk produced, increase in live weight, or straw eaten. The quality of the milk produced by the lot fed concentrated foods with no roots was on the average somewhat better than that produced when roots were fed, except in case of the lot fed roots in addition to the concentrated foods, the milk of which contained slightly more fat than that from the other lots. There was an increase in milk yield of 2.1 lbs. per head per day when roots were fed as an additional food.

The third year's experiments (1890) were a continuation of the experiments of the preceding years, the only difference being in the quantity of roots fed, which was somewhat larger. Eight estates took part in the experiments, with 304 animals in all. The results of the second year's experiments were confirmed in all essential points.

In the fourth and fifth years' experiments (1891 and 1892) grains and oil cakes were compared. Eight estates took part, and the number of cows included was 480. An abstract of these experiments has been given (E. S. R., 4, pp. 601–606).

The sixth and seventh years' experiments (1893 and 1894) were a comparison of grains and wheat bran. Seven estates took part, 487 cows being included. An account of these experiments is given on page 657 of the present number of the Record.

Both on account of the large number of animals included in these experiments and the systematic and painstaking manner in which they have always been conducted, the results obtained come with a great deal of force and carry conviction with them. When published they have by general consent settled questions previously debated. The influence of the experiments in European countries has also been great, and they have for all time put an end to feeding experiments conducted with one or two cows, or lasting only a couple of weeks or less. They bear a relation to Danish dairying and to the dairy world similar to that which the Rothamsted experiments bear to general agricultural practice. While of much more recent inception than these, they have furnished us with equally reliable information concerning the problems investigated. In originating and perfecting this system of coöperative feeding experiments Professor Fjord has erected a monument for himself that will always bear witness of his genius, the usefulness of which is increased with each new investigation added to the series.

HEAT EQUIVALENT OF THE NUTRIENTS OF FOOD.[1]

F. Stohmann, Ph. D.,

Director of the Agricultural-Chemical Institute of the University of Leipsic.

INTRODUCTION.

For the maintenance of life in the broadest sense of the word, the life of plants as well as of animals, a regular supply of new material which we call food is necessary.

This serves in part for the building up of new tissue, in part for replacing the tissue lost through metabolism, but most of all in furnishing the force or energy which makes life possible, whether it manifests itself as vital force, heat, or in electrical phenomena. The consumption of food is therefore chiefly valuable in giving the body the energy necessary for maintaining life.

In this last respect there is apparently a fundamental difference between the life of plants and of animals. Although plants can build their tissues from inorganic materials, namely carbon dioxid, water, nitric acid, and certain salts, and although these are regarded as nutrients, yet they can give no energy to the plant and, if the energy necessary to life must be furnished by the food, they can not in the strictest sense be called nutrients. To become such the inorganic substances are changed in the chlorophyll apparatus of the plant into organic compounds laden with energy. This change is effected through the agency of energy in the light and heat of the sun's rays. This is necessary in order to provide the energy which is as necessary for the plant as for the animal. In reality the plant does not live upon carbon dioxid, water, and the like, but upon organic substances elaborated by the energy of light in peculiar organs which are present in many plants but are lacking in others. The plants which lack these organs are not capable of utilizing the inorganic compounds. In order to build tissue and carry on the functions of a living organism they must feed upon organic, energy-furnishing material. Carbon dioxid, water, and nitric acid are therefore not the food of plants but only the materials from which certain plants can form food.

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[1] Translated by C. F. Langworthy, Ph. D.

But even those plants which possess the power of transforming inorganic into organic matter can do this only under two conditions. A chlorophyll apparatus is necessary, and this must be acted upon by light and heat waves of definite intensity.

While the seed is sprouting and the first organs of the young plant are being formed, the organism subsists on food which was stored up in the seed, and not upon carbon dioxid, water, etc. This food furnishes not only the material from which new tissue is produced, but also the energy which each organism must have from the first moment of its existence. The energy furnished by the organic material of the seed takes the form of heat and furnishes the considerable quantity of vital force which the young plant needs in overcoming the obstacles to its existence. It is no slight task for the delicate sprouting plant to force away the earth which covers it and work its way to the light. When this is accomplished, although the young plant be kept away from the light or the amount of heat be insufficient, it will nevertheless grow, but without being benefited by the carbon dioxid, etc., even if they are present in abundance. The growth and strength are all derived from the material stored up in the seed, and growth continues only as long as the supply lasts.

The inorganic substances are valuable for plants possessing chlorophyll apparatus only so long as the conditions prevail which favor assimilation. When sunlight is lacking no new organic material is formed. However, the plant lives, grows, and breathes as energetically, and perhaps even more energetically, during the night than during the day. It lives, grows, and breathes both by night and by day from organic, energy-furnishing substance. We must, therefore, consider that the green plants and those lacking green color agree essentially as regards the condition of nutrition.

The green plants differ from the others only in that they possess organs which have the power of utilizing the energy which comes to them from the sun. They can break up the carbon dioxid and change it into organic compounds which serve for food and other requirements of the plant, and thus a large part of the energy of the sunlight is stored up in the newly formed organic compounds.

Just as all plants live upon organic compounds which they themselves produce or obtain ready-made from some other source, so all animals also live upon organic substance.

Herbivorous animals live upon the substances stored up in the plants, and carnivorous animals upon the substances which the herbivorous animals, which become their prey, have obtained from plants.

There is no more a fundamental difference between plant and animal life than there is between green plants and those lacking chlorophyll. The conditions essential for life in the plant and animal world are therefore alike. The plant which lacks green coloring matter perishes when

the required amount of energy in the form of organic matter is not forthcoming. Under the same conditions an animal starves also.

If by artificial means the chlorophyll apparatus is hindered from its normal functions the sprouting plant lives only until reserve material in the seed is exhausted. Plants with green leaves increase in weight and store up reserve material in their tissues and organs, and build new tissue and new organs when the conditions are such that they can produce more organic substance than is necessary for bare existence. When an animal obtains more organic substance than is necessary for carrying on its life processes, be this the production of heat or muscular energy, the excess is stored up in the organism in the form of fat, just as in plants, under like conditions, starch, sugar, and fat are stored up. Although normal growth in a plant or animal is completed by the aid of organic substances, the inorganic compounds are also necessary. Without certain salts it is impossible for a plant to produce organic substances or for an animal to maintain life. This fact is self evident and is only mentioned to avoid the possibility of misunderstanding.

Organic substances furnish the animal almost entirely, and the plant in large measure, with the energy necessary to sustain life processes.

The determination of the heat equivalent of these substances must be of the greatest importance in the study of the laws of nutrition, since it furnishes a means of measuring the potential energy in these compounds.

I have devoted much time to the study of this problem since 1877. At that time only one publication on the subject had appeared. This was by Frankland,[1] in 1866. He followed a method of investigation devised by Lewis Thompson. This consisted in mixing the organic substance in the proper proportion with potassium chlorate and burning it in a calorimeter in such a manner that the gases of combustion passed through water and there gave up their heat. The method seemed extremely simple, and the apparatus was so easily made that apparently it was only necessary to follow in Frankland's footsteps to obtain satisfactory results.

On close examination, however, it became apparent that neither the method nor the apparatus as Frankland used it sufficed for accurate results. It was also evident that it was only necessary to eliminate certain errors from the method to make it available for exact research.

I described an improved method in 1879.[2] But even in this form the method and apparatus were not sufficient for such results as I desired to obtain. Many improvements were made and many earlier results were thrown aside until at last, in 1884,[3] the method was perfected. In elaborating the method the difficulties to be overcome arose from the

[1] Phil. Mag., 4th ser., 32, p. 182.

[2] Jour. prak. Chem., 19, p. 115.

[3] Landw. Jahrb., 13 (1884), p. 513.

fact that the combustion was not a direct one, but was accompanied by a number of the secondary reactions, some of which influenced the results on the positive and some on the negative side. These errors could only be estimated by indirect methods, for at the time these investigations were made there was not a single substance available whose heat of combustion had been determined by reliable methods. Had we then possessed a substance with a known heat of combustion, so that a definite amount of heat could be produced at will, it would have been an easy matter to determine the absolute value of these secondary thermal processes. In the determinations, however, the constants representing these secondary thermal processes had to be learned by indirect and tedious methods, and as a matter of course each error in the constants affected the final results.

In the course of time the discovery of Berthelot's bomb made possible great progress in thermochemistry, since it is an instrument which measures the heat of combustion of all combustible compounds with astonishing accuracy.

We have used this apparatus since 1887.[1] I have described it in detail in a former publication.[2]

We have repeated with it nearly all the experiments made by the potassium chlorate method. This repetition has shown that in these earlier results there is a constant error, although these results agree very nearly with each other. This error is seldom over 2 per cent, often less, and is always on the same side. If this amount is added to the results obtained by us with the potassium chlorate method, values are obtained which are accurate enough to meet the present requirements.

This error, which in many cases is of very little moment, is due to the fact that in spite of all effort it was not possible, with the indirect method then available, to estimate accurately the value of the constants which represent the secondary thermal processes in the combustion.

I think I owe it to myself and those who have worked with me, since we have worked so earnestly, to make these explanations here, and it is also desirable to do this since the method we had followed has been the subject of much unjust criticism. The potassium chlorate method was abandoned, not because with the improvements I had made it was inaccurate, but because the Berthelot and Mahler apparatus was much

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[1] Berthelot's apparatus consists of a steel bomb, cylindrical in form and lined with platinum. The substance to be burned is held in a platinum crucible inside the bomb. Oxygen is forced into the apparatus until the pressure is 20 or 25 atmospheres. The bomb is immersed in water and the substance is ignited by an electric current. The rise in temperature of the water shows the amount of heat produced by the combustion of the substance. The apparatus is described in Bulletin No. 21 of the Office of Experiment Stations on Methods and Results of Food Investigation.

[2] Jour. prak. Chem., 2d ser., 39, p. 503.

easier to use, and because it was peculiarly suited to determining the heat equivalent of many compounds which can not be determined at all by the potassium chlorate method, for instance, those which are easily volatilized.

The principle on which the Berthelot apparatus is constructed is this: A weighed quantity of the substance under investigation is burned in an atmosphere of oxygen under high pressure, sometimes twenty-five atmospheres, and the heat liberated is collected in a known quantity of water. From the rise in the temperature of the water the heat equivalent of the substance can be calculated.

Details of the process may be found in the article quoted above. Mahler's apparatus gives as good results as Berthelot's. It differs from Berthelot's in that it is simpler in construction and hence easier of manipulation. In each apparatus there is complete combustion to the final decomposition products; in the case of albumen, for instance, to carbon dioxid, water, nitrogen, and sulphuric acid. There are no side products with the exception of a little nitric acid, but the quantity of this can be easily determined, and the heat due to its formation taken into account in the calculations.

The purpose of this article is not so much to give results hitherto unpublished as to collate what is known of the heat equivalent of those compounds which are interesting from a physiological standpoint, so that these facts will be available for practical use. The original data are scattered through a considerable number of publications. All our results here cited were obtained from combustions made with the Berthelot apparatus, and are the mean values of several determinations which agreed very closely with each other. They are also in most cases compared with similar results obtained by Berthelot.

I. PROTEIDS.[1]

Under ordinary circumstances the complete combustion of albuminoids is very difficult to accomplish. In the bomb, however, under a high pressure of oxygen, and also by the potassium chlorate method, which furnishes an abundance of oxygen, it is a very easy matter.

The figures in the following table are derived entirely from our determinations made with the Berthelot apparatus. A comparison of these results with those obtained by the potassium chlorate method follows later on.

Each specimen of albuminoid substance used was as pure as it could be obtained; that is, in each case it was extracted with ether to free it completely from fat.

Besides the heat equivalent, the elementary composition of each substance was determined and the heat equivalent recalculated on an ash-free basis. It should be borne in mind, in explanation of the

[1] Jour. prak. Chem., 2d ser., 44, p. 336.

figures given here and later, that the small calorie denotes the amount of heat required to raise 1 gm. of water of about 17° one degree in temperature, and that the large calorie denotes the amount of heat needed to raise 1 kg. of water of about 17° one degree. Where not otherwise specified the large calorie is meant.

Heat of combustion and elementary composition of albuminoid substances.

Substance.	Heat equivalent per gram.	Elementary composition.					
		Carbon.	Hydrogen.	Nitrogen.	Sulphur.	Oxygen.	Chlorin.
	Small calories.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Plant fibrin	5,941.6	54.39	6.92	15.39	1.02	22.28	....
Serum albumen	5,917.8	53.93	7.65	15.15	1.18	22.09	....
Syntonin	5,907.8	53.64	7.44	15.76	1.09	22.07	....
Hemoglobin	5,885.1	54.73	6.06	16.50	.46	22.25	....
Milk casein I	5,867.0	54.02	7.33	15.52	.75	22.38	....
Milk casein II	5,849.6	54.14	6.85	15.61	.78	22.62	....
Yolk of egg	5,840.9	53.50	7.31	15.26	1.11	22.82	....
Legumin	5,793.1	53.22	7.17	15.18	.46	23.97	....
Vitellin	5,745.1	50.27	7.90	16.04	1.09	24.70	....
Egg albumen	5,735.2	52.95	7.50	15.19	1.51	22.85	....
Fiber of meat (extracted with water)	5,720.5	52.11	7.10	16.44	1.03	23.32	....
Albumen (crystallized)	5,672.0	51.48	6.76	18.14	.96	22.66	....
Meat, free from fat	5,662.6	....	....	16.38	1.09	....	....
Do	5,640.9	52.02	7.30	16.36	1.01	23.31	....
Blood fibrin	5,637.1	52.93	7.16	16.72	1.13	22.06	....
Harnack's albumen	5,553.0	50.69	6.68	14.51	1.89	23.67	2.56
Conglutin	5,479.0	50.78	6.74	17.51	.79	24.18	....
Peptone	5,298.8	50.10	6.45	16.42	1.24	25.79	....

It is no more possible to speak of one value for the heat equivalent of the albuminoids than it is to speak of a single uniform chemical composition for the entire group. The heat equivalent is, however, unquestionably proportioned to the amount of combustible elements. It is often necessary to base calculations upon an average albuminoid, and so also it is necessary to use an average heat equivalent, notwithstanding the fact that the variations in the heat equivalent of the different albuminoids may be quite considerable. This average value is found to be 5,730.8 small calories per gram, and corresponds to the average elementary composition.

	Per cent.
Carbon	52.71
Hydrogen	7.09
Nitrogen	16.02
Sulphur	1.03
Oxygen	23.15
	100.00

Berthelot, who also investigated albuminoids, obtained 5,691 small calories as the heat equivalent. This number is so near ours that the mean between the two, 5,711 small calories, can be taken as the most probable value. Comparison of the results thus obtained with those

obtained with the same substances by the potassium chlorate method shows the following relation:

Heats of combustion by old and new methods.

Material.	With oxygen.	With $KClO_3$.	Relation of determinations by two methods.
	Small calories.	*Small calories.*	
Casein	5,858.3	5,717	97.59
Egg albumen	5,735.2	5,579	97.28
Crystallized albumen	5,672.0	5,598	98.70
Fibrin	5,637.1	5,511	97.76
Conglutin	5,479.0	5,362	97.86
Average of all albuminoids	5,711.0	5,567	97.48

From the standpoint of thermodynamics the albuminoids are never completely consumed in the animal body. Only in isolated cases, with an absolute meat diet, for instance, is the digestion of albuminoids at all complete. Generally a considerable part of the albuminoids of the food passes through the body undigested. Herbivorous animals digest only 50 to 80 per cent of the albuminoids, the amount varying somewhat with the character of the food. Furthermore, when an albuminoid is digested in the animal body it never gives up all its energy, but breaks up, leaving urea and other nitrogenous products unoxidized. These cleavage products, which are excreted, are laden with energy which can not, however, be used to advantage by the animal organism. The amount of energy of the albuminoid which is really utilized by the organism, be it little or great, is determined by the quantity and character of these cleavage products which are excreted.

Let us suppose that in a given case the food consumed contains an average albuminoid, with 16 per cent of nitrogen, and yielding 5,711 small calories, and that the total nitrogen is excreted in the form of urea. One gram of albuminoid yields 0.3428 gm. of urea, 1 gm. of urea yields 2,537 small calories; hence the above quantity yields 8,697 small calories—that is, 15.23 per cent of the energy of the albuminoid is not utilized.

In another case let the albumen be in the form of conglutin, which contains 17.51 per cent of nitrogen and furnishes 5,479 small calories. Under the same conditions as before 1 gm. of conglutin yields 0.3752 gm. of urea with 951.9 small calories. Therefore, 17.37 per cent of the energy of the conglutin is lost to the organism.

In very many cases, however, the cleavage of the albuminoid does not progress as far as urea. A part of the nitrogen is used in forming uric acid and other cleavage products. Herbivorous animals often excrete a considerable part of the nitrogen as hippuric acid. It may be easily shown by thermochemical methods that only the glycocol group of the hippuric acid molecule is derived from albumen. Now, 1 gm.

of albumen containing 16 per cent of nitrogen would yield 0.857 gm. of glycocol. The heat equivalent of glycocol is 3,128 small calories. The heat equivalent of the above quantity is, therefore, 2,681 small calories; or, in other words, 46.95 per cent of the energy of that part of each gram of albumen which is transformed into glycocol is lost to the organism.

The chemical changes which take place in the animal body are most varied. Sometimes a larger, sometimes a smaller, part of the albumen is excreted by the organism unchanged owing to incomplete digestion. Furthermore, a considerable part of the energy is lost to the organism by the formation of the most varied cleavage products. One is thus forced to accept the conclusions which I have already pointed out,[1] namely, that when the transformation of energy which takes place in the animal organism is to be measured exactly, the heat equivalent of all the products which enter and are excreted from the organism must be known, and, further, values must not be used in calculations which are based on insufficient experimental data. Instead of this it is better to be content with less accurate calculations and to take the value found by assuming that urea is the only cleavage product, bearing in mind that thus the real value of the albumen is overestimated. That only the part of the albumen which is digested is referred to here goes without saying.

Rubner[2] characterizes my standpoint as "a very remarkable conclusion," with which he finds it difficult to agree. I, for my part, can not believe that it is possible from a single series of experiments, even if it was of five days' duration, to devise a general value for the quantity of energy of albumen which is really utilized. When Rubner finds that a dog on a meat diet loses in the feces and urine 23.2 per cent of the energy contained in the albumen consumed, I do not wish to cast the slightest doubt on his figures, but I must still consider it incorrect to apply these figures to other cases where the amount of the feces and the quantity of the cleavage products which are produced along with the urea are entirely different from those in Rubner's experiments.

I insist, therefore, that in an exact investigation of the metabolism of energy the heat equivalent of the products which enter and are excreted from the body must be determined. If one is not in a position to do this, approximately accurate results will be obtained if the full value of the digestible albumen in the diet is taken. For very many cases this is known, so for each gram of albumen 5,711 small calories are to be added and for each gram of the urea 2,537 small calories are to be deducted from the sum total. The amount of urea can of course be easily and directly determined. There are to be deducted for the heat of solution of urea 21 small calories per gram and for each gram of hippuric acid 1,311 small calories. The number, 1,311 small calories,

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[1] Jour. prak. Chem., 44, p. 351.

[2] Ztschr. Biol., 30, p. 89.

indicates the heat equivalent of the quantity of glycocol which is produced by the splitting up of 1 gm. of hippuric acid.

Gelatinoids.—In addition to the true albuminoids the heat equivalents of a number of so-called gelatinoids have been determined, with the following results:

Heat of combustion and elementary composition of gelatinoids, etc.

Substance.	Heat equivalent per gram.	Elementary composition.				
		Carbon.	Hydrogen.	Nitrogen.	Sulphur.	Oxygen.
	Small calories.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Elastin	5,961.3	55.03	7.20	16.91	0.18	20.68
Wool fiber	5,510.2	50.20	6.72	16.54	3.70	22.84
Fiber of skin	5,355.1	49.92	5.75	18.01	.30	26.02
Chondrin	5,130.6	49.14	6.67	15.37	1.26	27.56
Osseïn	5,039.9	48.63	6.64	16.34	.95	27.44
Fibroin	4,979.6	48.63	6.08	18.97		26.32
Chitin	4,650.3	45.15	6.40	6.86		41.59

Cleavage products of proteids.—In the following table are included the most important derivatives produced in the metabolism of proteids in the organism.

Under the head of heat equivalent the table shows the value obtained by the combustion of 1 gram molecule of the substance expressed in large calories, and also the amount of heat obtained by the combustion of 1 gm. of the substance expressed in small calories. For instance, if 1 gram molecule or 75 gm. of glycocol yields by combustion CO_2, H_2O, and N, a quantity of heat would be liberated sufficient to raise the temperature of 234.6 kg. of water (of about 17°) 1 degree, or where 1 gm. of glycocol burns to the same compounds sufficient heat is liberated to raise the temperature of 3,128 gm. of water 1 degree.

Derivatives of the proteids.

Substance.	Composition.	Molecular weights.	Heat equivalent.	
			Large calories per gram molecules.	Small calories per gram.
Glycocol	$C_2H_5NO_2$	75	234.6	3,128
Alanin	$C_3H_7NO_2$	89	387.7	4,356
Sarkosin	$C_3H_7NO_2$	89	401.1	4,507
Leucin	$C_6H_{13}NO_2$	131	855.8	6,533
Hippuric acid	$C_9H_9NO_3$	179	1,014.5	5,678
Aspartic acid	$C_4H_7NO_4$	133	385.2	2,896
Urea	CH_4NO	60	152.2	2,537
Asparagin	$C_4H_8N_2O_3$	132	463.5	3,511
Kreatin (crystallized)	$C_4H_9N_3O_2.H_2O$	149	553.3	3,713
Kreatin (water-free)	$C_4H_9N_3O_2$	131	560.0	4,275
Uric acid	$C_5H_4N_4O_3$	168	460.5	2,741
Guanin	$C_5H_5N_5O$	151	586.6	3,885
Caffein	$C_8H_{10}N_4O_2$	194	1,014.6	5,230

II. FAT.[1]

Fats of the animal body.—According to the investigations of Schultze and Reinecke[2], who investigated the fatty tissues of oxen, sheep, swine, dogs, cats, and man, fat has an almost uniform composition, though it be taken from various parts of the body and though it may have been formed under the most varied condition of life. The composition is:

	Per cent.
Carbon	76.50
Hydrogen	12.00
Oxygen	11.50
	100.00

Our investigations with the calorimeter, at first while using the potassium chlorate method, and later with Berthelot's bomb, have shown the heat equivalent to be so nearly the same for fat of all kinds of animals that it is impossible to find a noticeable variation for any particular sort. The first twenty three substances investigated included different kinds of fat from swine, oxen, horses, men, dogs, geese, and ducks. The mean value for fat obtained by the potassium chlorate method is 9,365 small calories per gram. Repeating the experiments with the Berthelot bomb gave, when a reduction to constant pressure was made, 9,500 small calories per gram; and the greatest variation from this value was not more than ± 0.2 per cent. The number, 9,500 calories, can therefore be considered the true mean value for animal fat. The relation between the earlier value and the correct one is as 98.57 : 100.

If we assume that animal fat is composed of equal molecules of tristearin, triolein, and tripalmitin, or what is just the same, that it is a mixed glycerin ether of the following composition:

$$C_3H_5 \left\{ \begin{array}{l} C_{18}H_{35}O_2 \\ C_{18}H_{33}O_2 \\ C_{16}H_{31}O_2 \end{array} \right.$$

the empirical formula of such an ether would be $C_{55}H_{104}O_6$ and the percentage composition:

	Per cent.
Carbon	76.75
Hydrogen	12.09
Oxygen	11.16
	100.00

This agrees very well with the mean value obtained by Schultze and Reinecke. We can calculate the heat equivalent of such an ether and thus have a control on the value which we find by experiment. The real heat equivalent of fat is found when from the sum of the heat equivalent of the glycerin and the acids which form the ether a small constant is deducted. This constant is very small in comparison to the whole

[1] Jour. prak. Chem., 2d ser., 31, p. 275; 42, p. 361.
[2] Ann. Chem., 142, p. 191.

sum. It is 8.2 small calories in the formation of trilaurin from glycerin and lauric acid and 4.3 small calories in the formation of trimyristin from glycerin and myristic acid[1]. In the formation of ethers from the unsaturated acids it is somewhat larger. In the formation of trierucin from glycerin and erucasic acid it is 23.2 small calories. The mean value of these three is 11.9 small calories and may be considered as a constant in the formation of the mixed ethers of all the fatty acids. The heat equivalent of 1 gram molecule would be as follows:

	Calories.
1 molecule of glycerin	397.1
1 molecule of stearic acid	2,711.8
1 molecule of oleic acid	2,682.0
1 molecule of palmitic acid	2,398.4
Heat of formation	−11.9
1 molecule of fat	8,177.4

or for 1 gm. fat, $\frac{8{,}177.4 \times 1{,}000}{860} = 9{,}509$ small calories.

The calculated value, therefore, agrees with 9,500 small calories, the value found by experiment.

Butter fat.—The fat of butter differs from the fat of animal tissues in this respect: it contains, in addition to the glycerids of the higher fatty acids, those of fatty acids which contain fewer carbon atoms. The chemically homologous acids form also a regularly progressing thermal series.[2] Therefore the glycerids of the acids which contain few carbon atoms must have a smaller heat equivalent than those formed from acids containing more carbon atoms. It was therefore probable that butter fat would have a smaller heat equivalent than the fat of animal tissue. Experiment has shown this to be the case.

By the potassium chlorate method the heat equivalent of butter fat was found to be 9,192 small calories per gram. The correct value, determined by combustion in the bomb, is 9,231.3 small calories per gram. These numbers are to each other as 99.57 :100.

Vegetable fat.—It is not possible that the vegetable fats should possess as regular composition and heat equivalents as the animal fats, since the glycerids which they contain are derived from the most various acids. Indeed, the same fats not infrequently show quite noticeable variations in thermal value. Little investigation in this field has been made, so it is impossible at present to say whether this variation is due to the fact that the plant may really produce fats of different composition under different conditions of growth, or whether it is due to the imperfect methods followed by the investigators.

We have investigated a large number of vegetable fats by the potassium chlorate method. We have not yet thought it necessary to repeat

[1] Jour. prak. Chem., 2d ser., 42, p. 376.

[2] Ber. math.-phys. Klasse kgl. sächs. Ges. Wissensch. Leipzig, 1893, p. 625; Jour. prak. Chem., 2d ser., 49, p. 108.

this work with the bomb, since the two methods gave such very small variations in the case of the other fats. We recalculate the earlier values, therefore, using the proportion found for animal fats which represented the relation of the results obtained by the two methods. This is 98.57 : 100. Thus the heat equivalent of 1 gm. of various substances is as follows:

	Small calories.
Linseed oil, first quality	9,488
Linseed oil, second quality	9,439
Olive oil, first quality	9,467
Olive oil, second quality	9,458
Olive oil, third quality	9,608
Poppy oil, first quality	9,597
Poppy oil, second quality	9,562
"Rüben" oil, *i.e.*, oil from seeds of various Brassicæ, first quality	9,627
"Rüben" oil, *i.e.*, oil from seeds of various Brassicæ, second quality	9,759

The fats obtained by extracting the seeds with ether vary somewhat from the oil obtained by pressure. All such fats have a somewhat lower heat equivalent than the expressed oils. This is evidently due to the presence of other substances which are also extracted by the ether. The ether extract of the green part of various plants has also a lower heat equivalent than any expressed oil. The following are heat equivalents of fats and allied substances extracted with ether:

	Small calories.
Flaxseed	9,262
Hemp seed	9,348
Poppy seed	9,470
Mustard seed	9,543
Rape seed	9,594
Seed of *Brassica campestris, rapa*, etc	9,604
Clover hay extract	8,926
Meadow hay extract	9,136

Vegetable wax.—The following figures may be cited:

	Small calories.
Japan wax from *Rhus succadanea*	9,130
Candleberry wax from *Myrica cerifera*	9,104
Carnauba wax from *Copernica cerifera*	10,237

Japanese wax is composed almost entirely of dipalmitin. The heat equivalent of dipalmitin is 9,123 small calories per gram. According to Moore[1] candleberry wax is largely free palmitic and myristic acids, together with a little of their glycerids. The heat equivalent of 1 gm. palmitic acid is 9,369 small calories; of 1 gm. myristic acid, 9,149 small calories. The above composition of the wax is therefore not correct. Carnauba wax is largely the ceryl ether of cerotic acid. Its heat equivalent must be much higher than that of fat.

[1] Husemann and Hilger, Pflanzenstoffe, p. 474.

III. THE CARBOHYDRATES.[1]

The heat equivalent of the so-called carbohydrates is given in the following table. All these results are from combustions made with the bomb:

Heat of combustion of carbohydrates.

Substance.	Composition.	Molecular weight.	Heat equivalents. Large calories per gram molecule.	Heat equivalents. Small calories per gram.
Pentoses:				
Arabinose	$C_5H_{10}O_5$	150	558.3	3,722.0
Xylose	$C_5H_{10}O_5$	150	561.9	3,746.0
Rhamnose	$C_6H_{12}O_5$	164	718.5	4,381.1
Rhamnose (crystallized)	$C_6H_{12}O_5.H_2O$	182	711.8	3,911.0
Fucose	$C_6H_{12}O_5$	164	712.2	4,342.7
Hexoses:				
δ-Glucose	$C_6H_{12}O_6$	180	673.7	3,742.6
δ-Fructose	$C_6H_{12}O_6$	180	675.9	3,755.0
Galactose	$C_6H_{12}O_6$	180	669.9	3,721.5
Sorbinose	$C_6H_{12}O_6$	180	668.6	3,714.5
Disaccharids:				
Cane sugar	$C_{12}H_{22}O_{11}$	342	1,352.7	3,955.2
Milk sugar	$C_{12}H_{22}O_{11}$	342	1,351.4	3,951.5
Milk sugar (crystallized)	$C_{12}H_{22}O_{11}.H_2O$	360	1,345.2	3,736.8
Maltose	$C_{12}H_{22}O_{11}$	342	1,350.7	3,949.3
Maltose (crystallized)	$C_{12}H_{22}O_{11}.H_2O$	360	1,339.8	3,721.8
Trehalose	$C_{12}H_{22}O_{11}$	342	1,349.9	3,947.0
Trehalose (crystallized)	$C_{12}H_{22}O_{11}.2H_2O$	378	1,345.3	3,550.3
Trisaccharids:				
Melitose	$C_{18}H_{32}O_{16}$	504	2,026.5	4,020.8
Melitose (crystallized)	$C_{18}H_{32}O_{16}.5H_2O$	594	2,019.7	3,400.2
Melicitose	$C_{18}H_{34}O_{17}$	522	2,043.0	3,913.7
Polysaccharids:				
Glycogen	$(C_6H_{10}O_5)x$	(162)x	678.9	4,190.6
Cellulose	$(C_6H_{10}O_5)x$	(162)x	678.0	4,185.4
Starch	$(C_6H_{10}O_5)x$	(162)x	677.5	4,182.5
Dextran	$(C_6H_{10}O_5)x$	(162)x	666.2	4,112.3
Inulin	$C_{36}H_{62}O_{31}$	990	4,092.1	4,133.5

Rhamnose and fucose were included in this list after careful consideration. Both have the composition $C_6H_{12}O_5$, and are not members of the same group as the others. Though they are pentoses they differ from the others in having a methyl group in place of one hydrogen atom.

Quite a number of the compounds given in the last table were burned earlier by the potassium chlorate method. The results by the two methods are compared below:

Results of combustions by the oxygen and potassium chlorate methods.

	Oxygen method.	Potassium chlorate method.	Ratio of results by two methods.
	Calories.	*Calories.*	
δ-Glucose	673.7	664.6	98.64
Galactose	669.9	658.6	98.31
Arabinose	558.3	554.2	99.27
Cane sugar	1,352.7	1,322.2	97.74
Milk sugar	1,351.4	1,325.9	98.11
Milk sugar (crystallized)	1,345.2	1,318.7	98.03
Melitose	2,026.5	1,979.7	97.69
Cellulose	678.0	671.7	99.07
Starch	677.5	667.9	98.58
Inulin	4,092.1	4,029.3	98.47

[1] Jour. prak. Chem., 2d ser., 31, p. 285; 45, p. 305.

The mean of all the ratios is 98.39. We found a similar relation in the case of albumens and fats. This bears out our opinion (see p. 593) that the results obtained by us several years ago by the potassium chlorate method were in fact relatively correct, and that the small variations from the real values were due to small errors made in the determination of the constants used.

When the figures in the table are compared it will be seen that the isomeric compounds have different heat equivalents, though the differences are not great. Since calorimetric measurements were not as exact as they now are, it was possible to explain these variations on the ground of accidents or errors of observation, as indeed was done by Berthelot. This is, however, not the case. The variations have an important meaning, and are in part due to the interior structure of the molecule, but especially to greater or lesser instability of the molecule. This instability of a molecule manifests itself in two ways; either the compound is easily decomposed by the action of certain agents, or the atoms within the molecule undergo a change in position. Such unstable bodies possess, without exception, a higher heat equivalent than the more stable ones. Of the four hexoses, $C_6H_{12}O_6$, there are two pairs which are certainly similar, glucose and galactose which are aldoses, and fructose and sorbinose which are ketoses. Of the two first glucose is less stable than galactose, since it is more easily broken up by the organisms which produce fermentation. Glucose ferments more easily than galactose. The heat equivalent of these two is:

	Calories.
Glucose	673.7
Galactose	669.9

The two ketoses behave in the same way. Fructose is less stable than sorbinose. It ferments more readily. Sorbinose is stable. It can not be decomposed by the yeast plant. The heat equivalents express this difference in stability.

	Calories.
Fructose	675.9
Sorbinose	668.6

In the same way, in the case of isomeric bodies, rearrangements of the atoms or groups of atoms in the molecule can occur without any change in elementary composition taking place. The unstable maleïc acid, $C_4H_4O_4$, is readily changed into its geometrical isomer, the stable fumaric acid.

The heat equivalents of these acids are as follows:

	Calories.
Maleic acid	326.3
Fumaric acid	319.7

Oleic acid and elaidic acid behave in the same way and erucic acid and brassic acid also.

Two isomeric bodies, one of which has the allyl group, $CH_2.CH:CH_2$, the other the propylen group, $CH:CH.CH_3$, by the change in position of one H atom become alike in structure. The change takes place

thus: The allyl group becomes a propylen group, but it is not possible to change the propylen group to the allyl group. The allyl compounds are unstable, in comparison with the propylen compounds. In proof of this the heat equivalent of the two compounds $C_{10}H_{12}O_2$ is:

	Calories.
Eugenol, allyl-dioxy-benzin-mono-methyl ether	1,286.9
Isoeugenol, propylen-dioxy-benzin-mono-methyl ether	1,278.1

A number of other instances of this sort may be cited.[1]

All the cases which have been mentioned (and there are very many more) have been grouped together under the general head of catalytic reactions, but no satisfactory explanation has been given up to this time. Thermochemistry has here filled up one gap in scientific knowledge.

If we consider what conditions are necessary to bring about a catalytic reaction we find we can distinguish two:

(1) Only those molecules which are in unstable equilibrium are subject to catalytic change. In hydrogen peroxid, the classic example of a catalytic reaction, the molecule is in the highest degree unstable. The atoms rearrange themselves with the greatest ease, forming molecules of water and oxygen. In the sugar molecule, the atoms are unstable; they change easily to the more stable molecules, alcohol and carbon dioxid. The disaccharids, the tri and polysaccharids are unstable in comparison with the hexoses, and are easily changed into these. In the ethers of the mon-atomic alcohols the atoms are in unstable equilibrium. They easily take on the elements of water and form acids and alcohols. The cases of maleic and fumaric acids and of allyl and propylen compounds were cited above. All these processes have one thing in common—they are without exception accompanied by a loss of energy.

(2) Catalytic reactions take place only in the presence of a second compound, which does not necessarily enter into the reaction, or they take place under the influence of some form of energy, the quantity being very minute.

The catalytic process which has been most thoroughly studied is the alcohol fermentation, which takes place through the agency of the alcohol ferment, the yeast plant or *Saccharomyces*. This, according to Pasteur, is to be explained as a physiological process of the yeast plant.

It is evident that this explanation does not "explain," but only states the same facts in a different way.

Liebig[2] looked at all fermentations from one general standpoint. He considered the ferments to be substances undergoing chemical change. The atoms in the molecules were in a state of violent agitation, and this motion tended to produce structural change. They could *impart* this motion to those substances which were capable of undergoing fermenta-

[1] Ber. math.-phys. Klasse kgl. sächs. Ges. Wissensch. Leipzig, 1892, p. 307; Jour. prak. Chem., 2d ser., 46, p. 530.

[2] Org. chem. in Anwendung auf Agricultur u. Physiol., 1840, p. 199.

tion. The atoms in the molecules of such substances would thus in turn assume new positions, and new compounds would be formed.[1]

In general C. von Nägeli's[2] explanation agrees with this. He defines fermentation produced by an organism as a transmission of the motion of molecules, atom groups, and atoms of the different compounds making up the living plasma to other compounds which can receive it, *i. e.*, which can undergo fermentation. The compounds which impart the energy remain unchanged. In those which receive it the equilibrium is destroyed and the compound is broken up.

The two explanations have this in common. A wave motion proceeds from the substance which produces the fermentation. This is communicated to the atoms of the substance to be fermented, sets them in motion, and finally they assume a new condition of equilibrium.

All the phenomena which are produced by the organized ferments are produced by the unorganized ferments also. The real cause must therefore in each case be the same. When the invertin produced by yeast breaks cane sugar up into glucose and fructose, when the pepsin of the glands of the stomach changes albumen into peptone, when the pancreatic juice changes starch to sugar and fats into glycerin and fatty acids, we see in each case the same sort of change, and in each case the causes must be the same.

Since analogous results are produced at one time by organized ferments and at another by unorganized ferments, one is forced to the conclusion that the *ferment organisms* do not produce the fermentation because they are *organisms* but only because they are the *carriers* of the real ferments. Alcoholic fermentation is no more produced by the yeast plant than albumen is digested by the cells of the peptic glands. Alcoholic fermentation is produced by a ferment peculiar to the living cell. It can not be separated from the cell, and when the cell dies it is also destroyed.

If we trace the cause of the widely varied forms of fermentation to molecular vibrations which are induced by the ferments the same must be true also for all kinds of catalytic reactions.

A fragment of fibrin in a solution of peroxid of hydrogen produces a violent evolution of oxygen, and water is formed. The motion which proceeds from the fibrin disturbs the equilibrium of the extremely unstable atoms in the peroxid of hydrogen, and causes a new arrangement of them. If other compounds which are also unstable, such as silver oxid, gold oxid, or lead peroxid, come in contact with hydrogen peroxid the motion of its atoms is so great that it reacts upon the atoms of the compound which produced it in the first place and decomposes that also.

One bubble of nitrous acid is sufficient to change an unmeasured quantity of oleic acid to elaidinic acid, since this produces the vibration in the atoms of the oleic acid necessary to effect the change.

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[1] Ann. Chem., 153, p. 1.

[2] Theorie der Gährung, Munich, 1879, p. 29.

We see everywhere catalytic reactions produced by motion, that is, by the introduction of some kind of force. The violent explosion of potassium chlorate by sulphur is to be referred to the same cause. The explosion which occurs with such violence when these substances are rubbed together is often explained by the heat due to the rubbing. This is entirely false. Experiment has shown that a mixture of potassium chlorate and sulphur may be heated above the melting point of sulphur even without any explosion. However, with careful heating, at a temperature of 142° an explosion takes place but with no violence. Nitroglycerin explodes with fearful force by a blow, but it burns without harm on glowing coals. It is not the heat from the rubbing or from the blow which is the cause of the explosion. Before this can take place the atoms of the molecules must be set in motion by a mechanical force, and it is this which produces the violent disruption.

Of the greatest interest also are the discoveries of Abel[1] and Champion and Pellet[2] on the transmission of the explosive force in explosives. If a little iodid of nitrogen is placed in one end of a glass tube 2.4 meters long and exploded the explosive force is transmitted to iodid of nitrogen in the other end of the tube. There can be no question of heat here. It can only be the atomic vibration caused by the first explosion which produces the explosion in the other end of the tube.

Vibrations of a definite character are necessary to produce an explosion. Iodid of nitrogen, when placed on the bass string of any stringed instrument, will not explode if a bow is drawn across the strings; but on the higher strings it will explode immediately. The explosion of one explosive body does not produce an explosion in a second unless the vibrations of the second are synchronous with those of the first.

Just as here the exciting cause is the motion which is given off by one body and which sets the atoms of a second body to vibrating so violently that they are torn apart, so is it also in the case of ferments and fermentable substances, or of nitrous acid and oleic acid, or of fibrin or silver oxid and hydrogen peroxid, or in the case of dilute acid and sugar, starch, and cellulose, etc. From each of these bodies vibrations must be produced of a definite wave length in order to cause a breaking up of the unstable molecule of the compound which is acted upon.

Berzelius considers the formation of ether from alcohol and sulphuric acid to be a catalytic reaction also. As soon as the various steps in the production of ether were understood this sort of catalytic reaction was no longer believed in. But it is going too far to deny it because many other processes are explained on purely chemical grounds.

Dilute acids split sugar up into glucose and fructose; dilute sulphuric acid changes cellulose and starch also into glucose. Since cellu-

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[1] Compt. Rend., 69, p. 105; 78, pp. 1227, 1301, 1362, 1432.
[2] Compt. Rend., 75, p. 210.

lose is soluble in concentrated sulphuric acid, and yields dextrin on the addition of water, the action of dilute acid on cellulose might be explained by the formation of cellulose-sulphuric acid as an intermediate product and the subsequent decomposition of this by water. This is, however, evidently incorrect. The formation of cellulose-sulphuric acid takes place only when water is not present. Thus the change of cellulose to sugar in dilute solutions can not be due to a cellulose-sulphuric acid.

The same is true also of the inversion of sugar by dilute acid, the change of starch to sugar, and the splitting up of ethers, glycerids, etc., due to the same cause. There is also this fact in addition: these reactions take place under the influence of all acids, but the cellulose and starch compounds of most acids are not known and in all probability do not exist. The action of the acid on the sugar is just like that of invertin, its action on starch the same as that of diastase. The action of acid on sugar, starch, and cellulose is just as much catalytic as the action of any ferment. Molecular vibrations are produced in these substances by sulphuric, hydrochloric, or oxalic acid just as much as they are in oleic acid by nitrous acid. Catalytic reactions can thus be brought about by the most varied substances, which do not of necessity produce the slightest chemical effect, and many such reactions can be produced by direct transference of force, as those produced by a blow or by rubbing.

The essential point is only that the substance causing the reaction has the power of producing a certain kind of motion in the atoms making up the molecules of the substance which undergoes a catalytic reaction.

Catalysis may be thus defined as a condition of motion in the atoms of unstable compounds which is produced by motion proceeding from some other substance, and which is accompanied by a loss of energy, and leads to the formation of new compounds.

Catalytic action would not have been dwelt upon so long if it did not play such an important part in the life of plants and animals. The entire digestive process in the animal from the taking in of food through the mouth to its excretion in the feces is one unbroken chain of catalytic reactions. We have just the same thing with plants. When the seed is sprouting, starch, fat, and albuminoids are changed into other compounds by catalytic processes. The transference of many substances from one part of a plant to another depends upon the same thing as does also the power of absorbing substances rendered soluble in the animal body.

This principle once recognized, it is perhaps going only a step further to ascribe the formation of all organic substances to catalytic reactions.

Ordinary starch and fat are generally considered to be the first substances produced by plants since they are found in the protoplasm of the plant containing the chlorophyll. Are these formed directly from carbon dioxid and water with liberation of oxygen? It seems much more probable that, according to von Baeyer's extremely ingenious

hypothesis, formic aldehyde, CH_2O, one of the most easily acted upon of all compounds, is formed from the carbonic acid CH_2O_3, a molecule of oxygen being liberated.

Von Baeyer is of the opinion that the formic aldehyde simply polemerizes to such compounds as sugar, etc. I am inclined to believe that the formic aldehyde first becomes a part of the protoplasm molecule, and uniting with the nucleii which are already present in the parent molecule, forms new protoplasm molecules. When, in addition, the reduction products of nitric acid, *i. e.*, ammonia, etc., enter into the molecule, it can grow, according to our ideas, almost without limit. If now by catalytic action the unstable molecule is broken up, its disunion can yield albumen, starch, and fat, while a nucleus remains behind to which the formic aldehyde and ammonia and like molecules can unite themselves again and build new protoplasm molecules.

The metabolism of protoplasm is constantly discussed, but no attempt is made to explain the causes which produce this metabolism. It seems to me that the foregoing is the most natural explanation. It is indeed a thousand times more probable that the metabolism of matter in animal cells depends upon just such causes, with this difference, ot course, that it is not formic aldehyde but organic substances which are carried to the plasma of the blood and absorbed by the plasma molecules. Here also large plasma molecules are built up of perhaps varying constitution. These molecules, under the influence of catalytic action which must perhaps be of a different kind for each sort of cell, break up and split off albumen, fat, sugar, and other compounds, leaving behind a nucleus which has the power of taking to itself the proper organic material and growing again to a plasma molecule.

Simultaneously with the catalytic reactions, processes of an opposite character must take place in the living cell. The catalytic action leads always to a breaking up of complex molecules into simpler ones, and is accompanied by a loss of energy. Thus we see a building up also in the vegetable organism; cellulose is formed from sugar, and albumen from asparagin and glutamin, and in the animal organism albumen is formed from peptones. In a word, we have to do with syntheses, and such syntheses not only lead to the formation of these compounds, but have a much more important meaning. They alone render possible the formation of protoplasm molecules. There is, further, this difference between catalytic and synthetic reactions: the first always liberates energy, the second always consumes energy.

Energy must be supplied to the compounds which take part in synthetical reactions. This is done in the chlorophyll cell by the action of light; in all other cells by the breaking down of other organic compounds or at the expense of energy liberated by catalytic reactions. Is there an equilibrium of force in the economy of nature so that the catalytic reactions produce as much energy as is required by the synthetical?

RECENT WORK IN AGRICULTURAL SCIENCE.

CHEMISTRY.

The determination of nitrogen in guano, E. HASELHOFF (*Landw. Vers. Stat., 43 (1894), No. 3 and 4, pp. 289–292*).—The author presents results of a number of determinations of the nitrogen in guano by means of the Jodlbauer method, which appear to indicate that this method is unreliable when applied to guano. As a check, ammonium compounds and nitrates were washed out of a second weighed portion in each case, and the nitrogen in this extract determined by the Ulsch method and in the residue by the Kjeldahl method. The results obtained by this means were as a rule considerably higher than those furnished by the Jodlbauer method, irrespective of the percentage of nitrate or moisture in the samples.

On the constant error in the determination of nitrogen by weighing the platinum obtained by igniting the ammonio-platinic chlorid, L. L. DE KONINCK (*Chem. Ztg., 18 (1894), No. 93, p. 1816*).—It is shown that in the determination of nitrogen by igniting the ammonio-platinic chlorid and weighing the metallic platinum there is a plus error of about one tenth per cent of the total found, due to the difference in specific gravity of the original substance taken and the platinum obtained. Thus in a substance actually containing 10 per cent of nitrogen there will be found by this method 10.01 per cent, an error which may be disregarded in ordinary analysis.

On the determination of the value of phosphoric acid insoluble in water, E. WRAMPELMEYER (*Landw. Vers. Stat., 45 (1894), No. 3 and 4, pp. 187–194*).—The results of determinations of the availability of the phosphoric acid in 24 samples of phosphates including different phosphorites, Redonda phosphate, Thomas slag, "prepared" phosphate, pure iron and aluminum phosphates, etc., by means of Jensch's 5 per cent citric acid solution, Scheibler's acid ammonium citrate (1 per cent excess of acid), Petermann's ammoniacal ammonium citrate (1 per cent excess of ammonia), and H. von Liebig's acid oxalate of potash solu-

tion[1] are reported. The more important of these results are shown in the following table:

Solubility of phosphates in different reagents.

	Total phosphoric acid.	Phosphoric acid soluble in—			
		Five per cent citric acid.	Acid ammonium citrate.	Ammoniacal ammonium citrate.	Acid oxalate of potash.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Osso phosphate	22.30	18.22	2.11	0.08	13.28
Somme phosphate	18.35	11.65	3.76	.32	14.91
Coprolite meal	21.71	20.67	4.99	.64	10.17
Redonda phosphate	33.28	1.92	.24	1.76	11.55
Thomas slag, old	21.06	20.93	8.98	1.76	3.71
Thomas slag new	15.60	15.42	8.58	2.80	3.33
Iron phosphate, dried	29.18	28.64	15.74	17.15	29.18
Iron phosphate, ignited	30.02	27.36	.32	.45	30.02
Aluminum phosphate, dried	38.98	38.98	22.40	36.99	38.98
Aluminum phosphate, ignited	43.14	43.14	9.92	34.62	43.14

It is suggested that Petermann's solution probably gives results more nearly approaching the actual availability of the different phosphates than any of the other solutions tested, but further experiments on this point are needed.

A new volumetric method for pure phosphoric acid solution, J. LANGER and C. GLÜCKMANN (*Pharm. Post., 27, pp. 369–371; abs. in Chem. Centbl., 1894, II, No. 13, pp. 600, 601*).—As a result of their tests the authors recommend the following method: Phosphoric acid is precipitated by magnesia mixture of known ammonia content and the excess of ammonia titrated with decinormal oxalic acid, using litmus as an indicator. Three molecules of NH_3 correspond to 1 molecule of H_3PO_4, thus:

$$H_3PO_4 + 3\,NH_3 = (NH_4)_3PO_4;\ (NH_4)_3PO_4 + Mg\,SO_4 = NH_4MgPO_4 + (NH_4)_2SO_4.$$

The magnesia mixture used contains 20 gm. of magnesium sulphate, 75 gm. of ammonia solution and 10 gm. of ammonium chlorid to one half liter of water.

The gravimetric determination of phosphoric acid by means of molybdate of ammonia, H. VON JÜPTNER (*Oesterr. Ztschr. Berg-Hütt, 42, pp. 471–473; abs. in Chem. Centbl., 1894, II, No. 19, p. 813*).—The author found that additions of considerable amounts of tartaric acid either to the phosphate or molybdic solution did not interfere with the phosphomolybdate precipitation. As high as 100 cc. of tartaric acid per liter of molybdic solution did not interfere with the precipitation. Molybdic solution containing tartaric acid had deposited no molybdic acid after standing 12 months at room temperatures. One hundred cubic centimeters of molybdic solution containing 0.2 to 0.6 gm. tartaric acid remained clear at 30° C.; containing 1 gm. or more,

[1] Fühling's Landw. Ztg., 1886, p. 68. The proportions used in this method were 2 gm. fine-ground phosphate, 5 gm. of acid potassium oxalate and 230 cc. of water.

remained clear at 40 to 50°; containing 1.5 gm. or more, at 60°; and 4 gm. or more, at 70 to 80°. Duplicate determinations of phosphoric acid in steel with molybdic solutions containing 6 gm. tartaric acid per 100 cc. gave closely concordant results. The tartaric acid was successfully used to prevent the precipitation of molybdic acid and iron oxid on warming.

Contribution to milk analysis, E. BECKMANN (*Milch Ztg.*, *23* (*1894*), *No. 44*, *pp. 702*, *703*).—*Fat determination.*—The author proposes to determine the fat as follows: 25 cc. of milk is placed in a stoppered glass cylinder with an equal volume of water, 2.5 cc. of standard acetate of lead added (5 cc. if milk is sour), shaken, and then sufficient sodium bicarbonate to separate the serum. The serum is then filtered off, the precipitate returned to the cylinder, mixed with glass pearls or bits of glass rods, and shaken with ether (3 or 4 times with 20 cc. each). The filter is also placed in a separate cylinder and shaken with ether. The ether layer is then poured off from the precipitate, the ether evaporated, and the fat weighed. The method is claimed to be equally safe for whole or skim milk, sweet or sour, and to require only 20 minutes. In 6 comparisons of the method with Soxhlet's aërometric method by different persons the largest difference was 0.07 per cent of fat.

Freezing point.—The author has found that the freezing point of whole milk is 0.54 to 0.58° C. (average 0.554°) lower than that of water, and that the depression of the freezing point below zero is proportional to the water added to the milk. He suggests this as a means of detecting water. The addition of 10 per cent of water depresses the freezing point 0.055°, which is believed to be a sufficient difference for practical discrimination.

Milk analysis, LESCOEUR (*Rev. Internat. Falsif.*, *8*, *p. 12; abs. in Chem. Centbl.*, *1894*, *II*, *No. 19*, *p. 816*).—To detect the addition of water, a little pulverized rennet is added to the milk sample. This coagulates the milk and the specific gravity of the serum is taken, which may vary from 1.029 to 1.031, and the total solids of the serum determined, which may vary from 67 to 71 gm. per liter. The addition of 4 per cent of water is said to decrease the specific gravity at 15° C. 0.001 and the solids 2 gm. per liter.

Examination of composite samples of milk, M. WEIBULL (*Chem. Ztg.*, *18* (*1894*), *No. 81*, *pp. 1567*, *1568*).—In previous articles (E. S. R., 6, p. 189) the author has advocated the addition of ammonia to milk that was sour or curdled in testing it for fat and specific gravity. He now sets forth the application of this in testing composite samples by mechanical or gravimetric methods. He refers to Farrington's proposition to add powdered lye to soured samples (E. S. R., 3, p. 150), but suggests that this would hardly be practicable where gravimetric methods were to be followed.

The separation and determination of milk fat, C. BOETTINGER (*Chem. Ztg., 18 (1894), No. 85, p. 1660*).—In a tube divided into 0.2 cc. are placed 6 cc. of milk and 1.2 gm. of incinerated silica and shaken for 5 minutes. In 3 minutes the milk curdles and in 5 minutes it is covered with a froth. The tube is carefully heated, avoiding boiling, until the fat gathers in a ring at the surface, usually about a minute. It is read off and then dissolved in ether, pipetted into a watch glass, the ether evaporated, and the residue dried at 100° and weighed. No tests of the accuracy of the method are reported.

Butter analysis, J. WAUTERS (*Rev. Internat. Falsif., 8, p. 12; abs. in Chem. Centbl., 1894, II, No. 19, p. 816*).—The following is recommended: Determination of water, salt, casein, and milk sugar; examination of butter fat; behavior of the butter on gradually melting; specific gravity at 100°; test with refractometer, oleorefractometer, or butyro-refractometer; microscopic examination of melted fat and residue insoluble in ether; determination of non-volatile insoluble fatty acids by Hehner-Angell method; determination of volatile acids by Reichert-Meissl method; determination of saponification number by Köttstorfer method, and of iodin number by Hübl method.

Detection of anilin colors in wine, SOSTEGNI and CARPENTIERI (*Staz. Sper. Agr. Ital., 1894, p. 151; abs. in Ztschr. Nahr. Hyg. Waar., 8 (1894), No. 17, p. 236*).—After the evaporation of the alcohol, the authors add 2 to 4 cc. of 10 per cent hydrochloric acid and boil with threads of fat-free wool for 5 minutes. The threads are washed with cold and then with hot water acidified with hydrochloric acid, then with water, and the coloring matter dissolved from them with a boiling mixture of 50 cc. of water and 2 cc. of ammonia. The threads are then removed, fresh ones added, the liquid acidified with hydrochloric acid, and boiled again for 5 minutes. The presence of coal-tar derivatives in the proportion of 2 mg. to the liter gives the following reactions: Vinolin, rose-red violet; Bordeaux red, rose-red violet; ponceau red, rose red; safranin, light rose-red; tropæolin, straw yellow; tropæolin, light orange.

The method is not suitable for fuchsin and corallin, as they are not fixed by this process. If it is desired the coloring material may be again dissolved from the threads with dilute ammonia, the solution evaporated to dryness, and the residue examined by means of the ordinary tests. This residue will contain some ammonium chlorid, however, and the hydrochloric acid evolved when treating with sulphuric acid will produce a slightly different color from that obtained with the pure coloring material.—W. D. BIGELOW.

Detection of anilin colors in wine, E. LUDWIG (*Ztschr. Nahr. Hyg. Waar., 8 (1894), No. 14, pp. 191, 192*).—After examining samples of pure red wines as well as of wines colored with 22 anilin derivatives, the author recommends that the Chazeneuve reaction with yellow mercuric oxid be adopted by the custom-house authorities, in addition to

the lead acetate and amyl alcohol methods now in use. He adds 2 centigrams of the mercuric oxid (Chazeneuve recommends 1.0 to 1.5 centigrams) to 10 cc. of wine, shakes vigorously in a test tube for 1 minute, and filters repeatedly through the same filter until clear. A colorless or slightly yellow filtrate indicates the absence of coal-tar derivatives, while their presence is shown by a red color.—W. D. BIGELOW.

Determination of extract in wine, T. OMEIS (*Chem. Ztg., 18 (1894), No. 85, p. 1660*).—The author considers that the various results obtained by different analysts in the determination of extract are largely due to the volatilization of glycerin. In the determination of extract he evaporates 50 cc. of the wine in a platinum dish on a gently boiling water bath until the contents of the dish begin to show a sirup-like consistence. Carrying the evaporation too far causes a loss of glycerin. The dish is then dried 2½ hours in a compartment of a water-drying oven, only one dish being placed in a compartment. The compartments are about 6 cm. high and 10 cm. square, are entirely separated from each other, and each is surrounded on all sides by steam. The author does not obtain comparative results with duplicates placed on different shelves of a larger drying bath, though the temperature on both shelves is the same. [This may be due to the fact that the water is in contact with the bottom of the drying bath, and dishes resting directly on it will be kept at a slightly higher temperature than those on a shelf passing through the center of the bath].—W. D. BIGELOW.

Determination of tannin in fruit wines, E. HOTTER (*Chem. Ztg., 18 (1894), No. 68, pp. 1305–1306*).—Owing to the constant decrease in the percentage of tannin (due to the presence of albuminoids) the author considers it essential that the tannin be estimated in a fresh sample. One hundred cubic centimeters of the fruit wine under examination and 50 cc. of strong alcohol are placed in a 150 cc. flask, mixed, and the flask filled to the mark with water. This is then filtered from the precipitated albuminoids, and measured portions treated in the usual way before and after treatment with boneblack.—W. D. BIGELOW.

The determination of glycerin in wine, P. KULISCH (*Forsch. ü. Nahrungsmtl., 1 (1894), p. 280; abs. in Chem. Ztg., 18 (1894), No. 84, Repert., p. 248*).—The author calls attention to several sources of error in the estimation of glycerin. First, some glycerin is volatilized when the alcohol-glycerin solution is evaporated too rapidly. He states that enough lime must be added to combine with all of the sugar present, as otherwise the glycerin will dissolve an appreciable amount of the sugar. He finds 1.5 gm. of calcium hydrate to be sufficient for each 2 gm. of extract in wines containing less than 3 per cent of sugar. The author considers that 25 cc. of the alcohol-ether mixture is not sufficient in all cases, and recommends that a larger quantity be employed.—W. D. BIGELOW.

The precipitation of lead from clarified wine and must, A. BORNTRÄGER (*Ztschr. angew. Chem., 1894, No. 18, pp. 554–559; No. 19, pp. 583–591*).—The author has continued his work on this subject (E. S. R., 6, p. 375) and compared sodium carbonate and sodium sulphate as reagents for removing the lead from clarified wine and must preparatory to estimating the sugar by titration. In addition to the objections which the author has previously made to the use of sodium carbonate for this purpose he calls attention to the yellow color which results from its use. Preference is given to sodium sulphate. He also finds that only a slight error is caused by the volume of the lead precipitate with the organic acids.—W. D. BIGELOW.

Aërometric wine analysis, SIDERSKY (*Rev. Chim. analyt., 2 (1894), p. 181; abs. in Chem. Ztg., 18 (1894), No. 70, Repert., p. 214*).—The percentage of alcohol and extract are calculated from the specific gravity of the wine, and of the residue left after boiling off the alcohol diluted with water to the original volume.—W. D. BIGELOW.

Proceedings of the eleventh annual convention of the Association of Official Agricultural Chemists, H. W. WILEY (*U. S. Dept. Agr., Division of Chemistry Bul. 43, pp. 403*).—This is the report of the convention held at Washington, D. C., August 23–25, 1894, an account of which has already been given (E. S. R., 6, pp. 178–186). In the latter account under "Soils and ash," p. 182, it is stated that "the acid soluble materials are to be determined in this dry soil, the results being reported on the air-dry basis." This should read: "The acid soluble materials are to be determined in the *air-dry* sample and the results calculated to the *water-free* basis."

The full report contains the reports for 1893 and 1894 of the abstract committtee of the association, including a large number of abstracts of articles relating to the analysis of fertilizers, feeding stuffs, dairy products, sugars, fermented liquors, etc.

The oil of the black walnut, W. E. STONE (*Agl. Sci., 8 (1894), No. 6–9, pp. 353, 354*).—By means of pressure about 19 per cent of oil was obtained from the kernel of the black walnut. Extraction with ether showed 55 per cent. The oil was of a pale straw color with a faint but agreeable taste and odor. After standing six months it remained free from unpleasant taste or odor. It was found to belong to the class of "drying oils." Its chemical and physical properties are described: "One of the valuable properties of the oil of the English walnut is its adaptation to the manufacture of an exceptionally fine varnish. So far as can be ascertained short of a practical test, our black-walnut oil possesses all the properties for a similar application and undoubtedly is capable of many practical uses should occasion demand."

The determination of nitrogen in urine according to Scheider-Seegen, F. VOIT (*Ztschr. Biol., 31, p. 168; abs. in Ztschr. analyt. Chem., 34 (1895), No. 1, p. 121*).

Chemical investigations of the slimy liquid which forms in distilled water, A. GOLDBERG (*Zwölfter Ber. Naturw. Ges. Chemnitz, pp. 56–67*).

On the leucin resulting in pancreas digestion, R. COHN (*Ber. deut. chem. Ges.*, *27, pp. 2727–2732; abs. in Chem. Centbl., 1894, II, No. 25, p. 998*).

The sugar resulting from indican, C. J. VAN LOEKEREN (*Landw. Vers. Stat., 45, No. 3 and 4, pp. 195–200*).

Investigations on the coloring matter of huckleberries, R. HEISE (*Arb. Kais. Gesund. Amt., 9 (1894), p. 478; abs. in Chem. Ztg., 18 (1894), No. 102, Repert., p. 327*).

On the coloring matter of grapes, L. SOSTEGNI (*Staz. Sper. Agr. Ital., 27 (1894), No. 4, pp. 400–413*).

Concerning substances occurring in some fruits associated with the wax substance, W. SEIFERT (*Landw. Vers. Stat., 45, No. 1 and 2, pp. 29–36*).

A new constituent of American grapes and the waxes of the latter, W. SEIFERT (*Landw. Vers. Stat., 45, No. 3 and 4, pp. 173–186*).

The ratio of dextrose to levulose in sweet wine and honey and the use of it in determining the adulteration of these substances, J. KÖNIG and W. KARSCH (*Ztschr. analyt. Chem., 34 (1895), No. 1, pp. 1–19*).

The carrying out of Fehling's titration in wine analysis, A. BORNTRÄGER (*Ztschr. analyt. Chem., 34 (1895), No. 1, pp. 19–25*).

Methods of analysis of must, M. GIUNTI and C. BOSCHI (*Staz. Sper. Agr. Ital., 27 (1894), No. 4, pp. 376–385*).

Sulphurous acid in wine, F. SCHAFFER, and A. BERTSCHINGER (*Schweiz. Wochenschr. Pharm., 32, pp. 397–404; abs. in Chem. Centbl., 1894, II, No. 24, pp. 958, 959*).—A careful study of the free and aldehyde sulphurous acid in wine.—W. D. BIGELOW.

Results of the investigation of Swiss wines of 1893, A. BERTSCHINGER (*Schweiz. Wochenschr. Pharm., 32, p. 305; ref. Chem. Ztg., 18 (1894), No. 76, Repert., p. 228*).

On the reaction of iodin on starch, E. DUCLAUX (*Ann. Inst. Pasteur, 8 (1894), No. 12, pp. 863–867*).—A critical review.

The preparation of litmus tincture, W. SCHÄFER (*Apoth. Ztg., 9, p. 839; abs. in Chem. Centbl., 1894, II, No. 26, p. 1061*).

A shaking machine for phosphoric acid determinations, H. WDOWISZEWSKI (*Ztschr. Stahl und Eisen, 13, p. 430; abs. in Ztschr. analyt. Chem., 34 (1895), No. 1, p. 68*).

A stirring machine for precipitating phosphoric acid, A. KELLER (*Chem. Ztg., 17, p. 1070; abs. in Ztschr. analyt. Chem., 34 (1895), No. 1, p. 69*).

The chemical laboratory of St. Petersburg University (*Chem. Ztg., 18 (1894), No. 97, p. 1903, figs. 2*).

BOTANY.

A new reagent for the demonstration of hydrogen peroxid in green plants, A. BACH (*Compt. Rend., 119 (1894), No. 26, pp. 1218–1221*).—The author has found that an acid solution of potassium bichromate and anilin violet is a very sensitive reagent for the determination of hydrogen peroxid, H_2O_2, in the green parts of plants. It will show the presence of 1 part in 1,400,000. The solution used contains 0.03 gm. potassium bichromate and 5 drops of anilin violet per liter. Of this solution 5 cc. is placed in a test tube, to which 5 cc. of the solution to be tested and 1 drop of a 5 per cent solution of oxalic acid are added. The presence of hydrogen peroxid will change the color of the solution to a rose violet. For comparison, in another tube are placed 5 cc. of the solution, 5 cc. water, and a drop of the oxalic-acid solution.

In experimenting the method of procedure is to soak 25 gm. of green leaves in a porcelain cup with 75 cc. of 1 per cent solution of oxalic acid. The cup is covered with a saucer and set aside. From time to time 5

cc. of this solution is removed and tested as above, comparisons being made as already indicated. It is stated that tannin is the only substance that is liable to cause confused results, and on this account the use of mineral acids is to be avoided in soaking the leaves.

The author tested 25 species of plants, and 18 gave results indicating the presence of hydrogen peroxid, as follows: *Brassica asperifolia*, *B. oleifera*, *Daucus carota*, *Beta vulgaris*, *Geranium rotundifolium*, *Hedera helix*, *Aster*, *Tropæolum pentaphyllum*, *Chrysanthemum balsamita*, *Mercurialis annua*, *Urtica*, *Caltha palustris*, *Vicia faba*, *Papaver rhœas*, *Sysimbrium nasturtium*, *Dianthus caryophyllus*, *Apium petroselinum*, and *Fragaria vesca*. Two species gave doubtful results, *Lactuca sativa* and *Vicia* sp., and 5 gave negative results, as follows: *Medicago sativa*, *Cichorium intybus*, *Avena sativa*, *Viola odorata*, and *Lilium bulbiferum*. These experiments show the presence in the green parts of many plants of hydrogen peroxid or peroxids capable of acting as such.

Investigations of the root tubercles on leguminous plants, W. WILSON (*Agl. Sci.*, *8* (*1894*), *No. 6–9*, *pp. 437–439*).—The author, in a letter from Aberdeen, Scotland, gives as the results of his observations the conclusion "that leguminous plants produce tubercles most abundantly where the conditions are favorable for the growth of the plants themselves, and not where the plants must struggle for their existence." He finds tubercles very abundant on *Cytisus scoparius* where the plant grows luxuriantly, while on the roots of plants growing on hillsides there will be few or none. In the case of *Genista anglica* tubercles are produced in abundance on dry moor plants, while those growing in better soil are almost wholly without them. *Ulex europeus* in poor soil will produce abundant tubercles, and the author thinks its value for restoring thin soil is due to this fact. The author states that red clover will not produce tubercles if grown in a climate too cold for the plant to mature its seed. He thinks that the failure to grow the improved *Lathyrus sylvestris* is due to the specific bacteria required for tubercle formation not being found beyond the limits where the plant finds congenial conditions for its growth and development.

A comparison between the same species of plants in the Arctics and Alps, G. BONNIER (*Rev. gén. Bot.*, *6* (*1894*), *No. 72*, *pp. 505–527*, *pls. 4*).—The author has made a comparative histological study of specimens of *Silene acaule*, *Oxyria digyna*, *Saxifraga oppositifolia*, *Salix reticulata*, *Cerastium alpinum*, *Potentilla nivea*, and *Poa pratensis*. Comparing the Arctic with the Alpine plants he finds that the former differ (1) in the tendency to a reduction in number of the lignified elements in the different parts of the plant, their walls being less thickened and having a smaller caliber of their vessels; (2) the leaves are more thickened but less differentiated, the palisade parenchyma is less marked and the intercellular spaces are greater; (3) the epidermis of the leaves and stems is less coherent and its cuticle less thickened; and (4) all the tissues, leaf, stem, and root, show a tendency to rounder cells, separating greater intercellular spaces.

These differences are considered due to the difference in humidity of the atmosphere and the amount of light found in the respective regions.

The origin of our vernal flora, J. W. HARSHBERGER (*Science, 1 (1895), No. 4, n. ser., pp. 92–98*).—The author traces the geological origin of many of our spring flowering plants.

A classification of Nicotianæ, O. COMES (*Novæ systemationis generis Nicotianæ, Hortus Botanicus Porticensis, 1894; briefly reviewed in Agricol. e Ind. Agr., 17 (1894), No. 23, p. 366*).

Revision of the North American species of the genus Cracca, A. M. VAIL (*Torrey Bul., 22 (1895), No. 1, pp. 25–36*).—A revision of the genus *Tephrosia*, with descriptions of new species and varieties.

The genus Ravenelia, P. DIETEL (*Hedwigia, 33 (1894), No. 6, pp. 367–371*).—Notes on distribution and descriptions of new species.

The inflorescence in descriptive botany, F. HY (*Rev. gén. Bot., 6 (1894), No. 70, pp. 385–408, figs. 15*).—The author makes a plea for a more definite and simple nomenclature in descriptive botany relating to inflorescence.

Injurious effect of nitric acid on plants, KÖNIG and HASELHOFF (*Landw. Jahrb., 22 (1894), No. 6, pp. 1031–1034*).

Contribution to the knowledge of the assimilation by leaves, R. MEISSNER (*Inaug. Dissertation, Bonn, 1894, pp. 48; abs. in Bot. Centbl., 60 (1894), No. 7, pp. 206, 207*).

Stem grafting, L. DE ROUSSEN (*Jour. Agr. Prat., 58 (1894), No. 32, pp. 205, 206*).—Theory in regard to the movements of the sap.

On a detailed botanical chart of France, C. FLAHAULT (*Compt. Rend., 119 (1894), No. 26, pp. 1236–1239*).

Contributions to the Queensland flora, F. M. BAILEY (*Queensland Dept. Agr. Bul. 9, p. 19*).—A list of additions to the previous contributions, together with descriptions of 6 new species and varieties.

METEOROLOGY.

An essay on southerly bursters, H. A. HUNT (*Jour. Roy. Soc. N. S. Wales, 28 (1894), pp. 48, pls. 4*).—These bursters prevail mostly from October to February, or during the summer. The greatest velocity of the wind was 153 miles per hour, and the average of the greatest velocities in 991 cases from 1863 to 1894, was 42.7 miles per hour. The lower strata of cloud move with the wind, while the upper strata are always from the west. They are invariably attended by strong electric action, a stream of sparks being sometimes produced for an hour at an electrometer. The advance of the true burster is indicated by a peculiar cloud or roll not dissimilar to that in the "pampero" of South America. Clouds of dust, which penetrate everywhere, announce the arrival of the wind; sand flies by overhead at less than 2,000 ft., and with great rapidity. Rain may follow. There seems to have been a rather marked diminution in the wind velocity in these bursters within 10 or 15 years. A burster is caused probably by a wind blowing from a high area over the ocean to the southwest of Australia into a hot dry condition of the atmosphere in the interior. It seems to be a sort of combination of a cold wind from the high area with an electric disturbance on the land. It has been compared with the norther of

Texas which, however, occurs in winter, and is due to cold air blowing down and out of a high area in the interior.—H. A. HAZEN.

Meteorological observations considered with special reference to influence on vegetation, P. SCHREIBER (*U. S. Dept. Agr., Weather Bureau Bul. 11, pt. 2, Rpt. Internat. Meteorolog. Congress, 1893, pt. 2, pp. 395–404*).—This article records in part the results of efforts "to determine how much of heat, water, and sunshine is required by different plants, and how these influential factors are to be distributed during the various phases of plant life." The nature and the difficulty of the investigations necessary to attain this object are briefly discussed. The desirability of "special endeavor to devise methods of representing large series of figures by mathematical expressions" is urged, and the attempt is made "to represent the results of a system of stations as functions of their position on our globe."

"If y denotes any given meteorological element, either the simple values of simultaneous observations, or the means of the observations for any given period, and $\psi\,\lambda\,h$ are the corresponding latitude, longitude, and elevation above sea of a place, then $y=f\,(h\,\psi\,\lambda)$.

"In the derivation of such formulas two methods can be employed. According to the first we lay down theoretically certain principles and endeavor to clothe them in formulas. According to the second, use is made of the serial form, as

$$y=y_0+bh+c\psi+d\lambda+eh^2+f\psi^2+g\lambda^2+\ldots$$

endeavoring to determine the values of the coefficients from the observations, and then see how these observations are expressed by the series.

"In most cases it will be found that all but the first two terms are negligible. The principal results of observations made from 1864 to 1890 at 15 stations in Saxony, representing elevations of from 120 to 930 meters have been compiled. All monthly and annual means thus found for periods of 5 and more years were represented according to the equation $y=a+bh$. This has therefore been named the fundamental equation and a the fundamental value, and b the coefficient of elevation."

The mean values themselves have already been published. A few of the principal results of the calculations under present consideration are here given:

"For the general mean temperature we have

$$a=9.29°\text{ C.}\pm 0.22°;\ b=-0.574°\pm 0.045°;\ \mu=\pm 0.43°.$$

"The coefficient of altitude is for each 100 meters; the mean error is represented by μ . . .

"A representation of the equation for the diurnal period is obtained from the equations for the temperatures at 2 p. m. t_2 and for the minimum temperatures t_m.

"It follows from

$$t_2=12.63-0.656\ h \text{ and } t_m=5.46-0.579\ h,$$

that $t_2-t_m=7.17-0.077\ h$, from which it will be seen that the range of oscillation is diminished 0.077° for each 100 meters additional height.

"For the 6 a. m., 2 p. m., and 10 p. m. observations the following values were obtained for the 25 years from 1866 to 1890:

$$t_6=6.82-0.463\ h$$
$$t_2=12.63-0.656\ h$$
$$t_{10}=8.37-0.614\ h$$

"Here we are impressed with the smallness of the coefficient of altitude for the hour of 6 a. m. It follows that, immediately after the time of the minimum temperature, during the first hours of the rise, there must exist a remarkable uniformity in the vertical distribution of temperature.

"Of interest is the equation $t_{10}-t_6=1.55-0.151\,h$ which shows that at elevations below 1,000 meters t_{10} is greater than t_6; in other words that the evenings are warmer than the morning hours. At elevations of 1,000 meters equal temperatures prevail at 6 a. m. and 10 p. m. . . . The equations applied to vapor tension show that the amount of aqueous vapor in the air decreases at the rate of 0.146 gm. per cubic meter for each increase of 100 meters in the elevation. For the periodic variations of vapor tension in millimeters at 6 a. m., 2 p. m., and 10 p. m. . . . the equations are

$$S_6=6.80-0.16h,\ S_2=6.89-0.103h,\ S_{10}=7.19-0.212h.$$

"It appears, therefore, that while the least vertical decrease of temperature occurs in the early morning, the least vertical decrease of vapor takes place during the afternoon. The greatest difference in the amount of watery vapor on mountains and over lowlands occurs at 10 p. m.

"Relative humidity, rainfall and snowfall, the frequency of rain, and the occurrence of night frosts are also treated by this formula to find the variation of these factors with change of elevation."

Following the same method with observations made during 1892 on the dates of blooming and harvesting of important field crops, the following fundamental equations were obtained:

	a	b	n	μ	μ_a	μ_b
Rye,	May 24	$+4.05h$	59	± 5.4	± 1.6	± 0.39 days.
Wheat,	June 17	$+2.83h$	28	± 4.4	± 2.1	± 0.67 days.
Oats,	June 28	$+3.41h$	41	± 6.5	± 2.3	± 0.57 days.
Barley,	June 17	$+4.76h$	12	± 7.4	± 5.8	± 1.80 days.
Potatoes,	July 3	$+1.82h$	23	± 6.8	± 3.0	± 0.76 days.

"[In these] n represents the number of stations from whose data the equations were determined, μ represents the mean errors of the results. . . .

"For the length of time between blooming and harvest the following equations were obtained:

	a	b	n	μ	μ_a	μ_b
Rye,	44	$+2.55h$	56	± 7.3	± 2.2	± 0.53 days.
Wheat,	41	$+1.97h$	27	± 5.1	± 2.5	± 0.78 days.
Oats,	27	$+3.22h$	38	± 7.9	± 2.7	± 0.63 days.
Barley,	42	$+0.07h$	9	± 5.2	± 4.8	± 1.45 days.
Potatoes,	75	$+0.94h$	16	± 10.5	± 7.7	± 2.05 days.

"If we combine the equations for time of blooming and for the difference between time of blooming and harvest, we obtain the equations for the date of harvesting:

Date of rye harvesting,	July 6 $+6.6h$.
Date of wheat harvesting,	July 28 $+4.8h$.
Date of oats harvesting,	July 25 $+6.6h$.
Date of barley harvesting,	July 29 $+4.8h$.
Date of potato harvesting,	Sept. 16 $+2.8h$."

It is of especial interest to observe in the above tables that the time of blooming of the principal cereals (rye, wheat, oats, and barley) is retarded from 3 to 4 days and for potatoes about 2 days for each increase of 100 meters in elevation, while the time of harvesting is retarded from 5 to 6½ days with cereals and 3 days with potatoes.—O. L. FASSIG.

Records of four voyages of the balloon Svea, S. A. ANDREE (*Bihang svenska Vet. Akad. Handl., 19 (1893), II, No. 3, pp. 20, pls. 3; 20 (1894). II, No. 1, pp. 36, pls. 6; No. 3, pp. 39, pls. 5; No. 4, pp. 16, pls. 3*).—The capacity of the Svea is 37,200 cubic feet. The voyages were made at Stockholm on July 15, August 9, and October 19, 1893,

and February 26, 1894. The following table indicates the principal points of interest in the records of each voyage. The temperature and humidity were obtained with a ventilated psychrometer and are undoubtedly quite accurate.

Observations in four balloon voyages.

	I.	II.	III.	IV.
Highest point	11,100 ft.	11,970 ft.	9,900 ft.	10,770 ft.
Starting temperature	52°	65°	36°	41°
Lowest temperature	19°	31°	16°	—2°
Diminution for 1°	324 ft.	350 ft.	475 ft.	239 ft.
Highest relative humidity	81 per cent at 4,070 ft.	77 per cent at 9,800 ft.	100 per cent at 6,160 ft.	80 per cent at 5,910 ft.
Lowest relative humidity	36 per cent at 9,530 ft.	21 per cent at 8,450 ft.	4 per cent at 7,980 ft.	52 per cent at 10,270 ft.
Lowest vapor pressure	0.04 per cent at 11,090 ft.	0.54 per cent at 8,450 ft.	0.001 per cent at 7,980 ft.	0.17 per cent at 10,270 ft.

These records are of the highest interest and are also the most accurate ever made in Europe. The diminution in relative humidity of 96 per cent in 1,820 ft. is the most remarkable ever noted, though a fall of 30 per cent in 400 ft. was noted at Washington, D. C., on October 27, 1892. Each one of these voyages showed remarkable fluctuations in the moisture conditions in horizontal layers at different heights, and this accords with the fact that specific clouds are found day after day at about the same level. Balloon records in this country and in Europe have all indicated a tendency for atmospheric moisture to occur in rather definite layers and have not shown vertical columns of approximately the same moisture distribution.—H. A. HAZEN.

Sanitary climatology, M. W. HARRINGTON (*U. S. Dept. Agr., Weather Bureau Circular 1, 1895, p. 1*).—This is a preliminary announcement of proposed investigations on "the subject of climate and its influence on health and disease. It is hoped to make the proposed investigation of interest and value to all, but especially to the medical and sanitary professions and to the large number of persons who seek, by visitation of health resorts and change of climate, either to restore health or prolong lives incurably affected or to ward off threatened disease. . . . The hearty coöperation of the various boards of health, public sanitary authorities, sanitary associations and societies, and of physicians who may feel an interest in the work" is sought in supplying accurate, complete, and prompt reports of vital statistics from different localities.

Weather forecasts in Australia (*Nature, 1895, Jan. 17, p. 278*).—A conference representing the 3 colonies of New South Wales, South Australia, and Victoria was held at Melbourne, October 29, 1894, and plans were formulated for systematic cloud photography at each observatory as an aid to weather forecasting and for distribution (daily except Sunday) of forecasts to all of the principal telegraph stations in each of the colonies. The system of storm signals used in England was adopted.—O. L. FASSIG.

Lightning record, I, H. F. KRETZER (*St. Louis: 1895, pp. 106*).—The object of the work is to call public attention to the great destruction caused by lightning. 1,970 cases of lightning strike in the United States in the past 4 years are catalogued and a handy index compiled showing the particular features of each strike. In the 5 years 1883 to 1887, 1,470 men were injured and 884 women; 742 men were killed and 25 women.—A. M'ADIE.

Rainfall of India, 1893 (*pp. 1,400*).—This is the third annual report of the Indian Government on rainfall observations. The system of observations in force in India is described and monthly statements of rainfall published by the various local governments for the year 1893 are included, the data in the majority of cases extending back 20 or 30 years. The averages thus obtained are utilized for the columns of normal values and for the comparison of normals with actuals.—O. L. FASSIG.

Jamaica rainfall for 1893, R. JONSTONE (*Government Pub. Kingston: 1894, Oct., pp. 8*).—The greatest rainfall for the year on the island was 177.34 in. at Fellowship and the smallest, 34.29 in. at Kingston. Six stations had falls exceeding 145 in. The largest monthly fall was 43.60 in. in December at Blue Mountain (7,000 ft.); the next largest at Hordby in October, 43.53 in. There were very remarkable falls at stations very near each other; for example, in January Richmond and Highgate, only 3 miles apart, had 1.08 and 10.63 in. respectively. In August Annotto Bay had 2.11 in., while Castleton Garden, 9 miles away, had 20.75 in. The rainfall for the year showed an excess of from 10 to 20 in. in the various parts of the island above the normal for 20 years.—H. A. HAZEN.

Windmills and meteorology, P. J. DE RIDDER (*Pop. Sci. Monthly, 1895, Feb., pp. 522–524*).

Means of protecting economic plants from frost injury, C. F. BECK (*Wie schützt sich der Landwirth am sichersten vor Frostschäden. Leipzig: Carl Scholtze, 1895*).

Instructions for obtaining and transcribing records from recording instruments, C. F. MARVIN (*U. S. Dept. Agr., Weather Bureau Circular A, Instrument Room, rev. ed., pp. 40*).—Instructions to observers of the Weather Bureau relative to the proper manner of compiling and transcribing meteorological data from instruments recording wind velocity, direction, and movement, air pressure, air temperature, sunshine, and rainfall. It contains a table giving local time of sunrise and sunset and approximate hours of possible sunshine for north latitudes, from 25 to 49°, inclusive; monthly amounts of possible sunshine for hours ending shortly after sunrise and sunset for the same latitudes; also a table showing depth of precipitation corresponding to given weights, designed especially for the measurement of snowfall.—O. L. FASSIG.

Instructions to special river observers of the Weather Bureau (*U. S. Dept. Agr., Weather Bureau, pp. 49, fig. 7*).—This is a new and revised edition of instructions issued by the Weather Bureau. The river gauges maintained by the Weather Bureau are mainly for the purpose of giving information of coming high waters in the case of freshets to places along the river below them; but the gauges are also useful for purposes of navigation. Various forms of river gauges are described and figured, as also the rain and snow gauges used by the Weather Bureau. The cipher code for telegraphing reports to the central office is included.—O. L. FASSIG.

Meteorological summary for October, 1894 (*Massachusetts State Sta. Bul. 56, p. 1*).—Notes on the weather and a summary of observations on temperature, precipitation, and prevailing wind.

Meterological summaries for North Carolina for September and October, 1894 (*North Carolina Sta. Weather Service Bul. 60, pp. 137–150, charts 2; 61, pp. 153–167, charts 2*).—The usual daily and monthly summaries of observations by the State weather service, coöperating with the Weather Bureau of this Department.

Meteorological observations at the City of Mexico and in Vera Cruz (*Ann. Observ. Astron. Nac. Tacubaya, 1895, pp. 288–352*).—A record of the ordinary elements of the weather for each day from December, 1892, to November, 1893, made at the City of Mexico and at Vera Cruz.

SOILS.

Destructive effect of winds on sandy soils and light sandy loams, with methods of protection, F. H. KING (*Wisconsin Sta. Bul. 42, pp. 29, figs. 16*).

Synopsis.—There are extensive areas of light sandy or sandy loam soil in Wisconsin well adapted to certain crops especially potatoes, on which crops are subject to serious injury by parching winds and drifting soil. From the results of field observations and of readings of evaporators and wet and dry bulb thermometers made to determine the influence of shelter in reducing this injury, it was found that to the leeward of woods, hedges, clover fields, etc., a beneficial influence was exerted to a distance of at least 300 ft. The means recommended for reducing the injury are frequent rotation in long, narrow strips of land, running as a rule at right angles to the direction of prevailing winds; use of an abundance of organic manures; leaving the ground rough after seeding; clearing woodlands in belts at right angles to prevailing winds, and planting windbreaks.

"There is a rudely crescent-shaped tract of land lying a little to the south of the center of this State and extending from Weyauwega, Berlin, and Portage on the east to Barron, Menomonie, and Pepin on the west, which is covered, over most of its area, outside of the swampy and marshy districts, with a light sandy soil or sandy loam." This tract is about 40 miles wide and fully 180 long. There are 3 isolated areas of a similar character and of considerable extent in the northern part of the State, besides smaller areas scattered throughout the State. It has been shown that these soils are well adapted to certain kinds of crops, especially potatoes, when properly managed, but that crops on them are frequently seriously injured or entirely destroyed by the parching winds or the drifting soil.

The results of observations during 4 days, commencing May 29, on the field conditions at different points in the first mentioned area, just after a destructive windstorm, are reported in detail. It was observed "that wherever a field lay to the leeward of any sort of shelter the bad effects of the wind were either not apparent or else were very much reduced." This influence was exerted to a considerable extent by fences, hedges, clover fields, etc., but was especially marked to the leeward of woodlands. Readings of evaporators and wet and dry bulb thermometers placed at different distances to the leeward of woods, hedges, and clover fields show that these exerted an influence on evaporation and humidity of the air to a distance of at least 300 ft. These observations "make it very certain that such destructive effects as have this year been experienced in Waushara and Portage counties can be prevented in the future in a very large measure and this, too, by simple and comparatively inexpensive measures."

The following means for accomplishing this purpose are recommended and discussed in detail: (1) Frequent rotation in long, narrow strips of lands running as a rule north and south, since the most destructive winds seem to come from the west; (2) increasing the

water-holding power of the soils by incorporating an abundance of organic manures in them; (3) leaving the ground uneven after seeding; (4) clearing the wooded lands in north and south belts; and (5) planting wind-breaks.

Evaporation of water under the influence of potash salts, M. MÄRCKER (*Neue Ztschr. Rübenz. Ind., 33, p. 89; abs. in Chem. Centbl., 65 (1894), II, No. 13, p. 595*).—Experiments in vegetation pots with potash salts on soils rich in potash showed that the beneficial effect of these fertilizers on such a soil was without doubt largely due to the conservation of moisture in the soil. This action declined after a time, but was revived by renewed applications of potash salts. It was observed that the effect on evaporation was not confined to the soil, but was exerted on the plants as well. The latter became richer in salts and therefore less subject to loss of moisture by transpiration.

Analyses of typical soils of the Island of Jersey, F. W. TOMS (*Ann. Rpt. Official Analyst of Island of Jersey for the year ending March 25, 1892, pp. 10–12*).—Complete chemical analyses of 5 soils are reported. The results of analyses of 3 of these selected as typical of the light, medium, and heavy soils of the island (unmanured) are given in the following table:

Composition (of dry matter) of typical Jersey soils.

	Light.	Medium.	Heavy.
Volatile and organic matter	3.590	3.760	3.980
Oxid of iron	0.910	1.724	2.245
Alumina	0.572	1.497	1.403
Lime	0.236	0.187	0.576
Magnesia	0.148	0.291	0.200
Potash	0.086	0.114	0.158
Soda	0.228	0.355	0.537
Phosphoric acid	0.128	0.131	0.195
Sulphuric acid	0.182	0.236	0.184
Chlorin	0.009	0.011	0.009
Carbonic acid	Trace.	Trace.	Trace.
Soluble silica	0.079	0.080	0.084
Hydrated silica	2.500	2.780	6.100
Insoluble silicates and quartz	91.332	88.834	84.329
	100.000	100.000	100.000
Nitrogen in organic matter	0.122	0.136	0.141
Nitrogen as nitrates (parts per million)	2.108	1.650	6.450

Muck and marl, R. C. KEDZIE (*Michigan Sta. Bul. 115, pp. 35–40*).—A brief popular treatise on the character, management, and utilization of the muck and marl deposits of Michigan.

Soil temperatures (*Ann. Observ. Astron. Nac. Tacubaya, 1895, p. 290*).—A 2 years' record of soil temperatures is given for the Tacubaya Observatory (Mexico), December, 1891, to November, 1893, with thermometers at depths of 3, 1.15, 0.70, 0.38, and 0.28 meters.—O. L. FASSIG.

FERTILIZERS.

The fertilizing value of different kinds of ground Thomas slag, crude phosphates, and the phosphoric acid of bone meal, M. MÄRCKER (*Jahresber. agr. Chem. Vers. Stat. Halle, 1893; Neue Ztschr. Rübenz. Ind., 33, pp. 81–84; abs. in Chem. Centbl., 1894, II, No. 13,*

p. 594).—The effectiveness of different kinds of Thomas slag was very variable, ranging from 57.8 to 95.6 per cent of that of a like amount of water-soluble phosphoric acid. No relation could be traced between the percentage of phosphoric acid present and its effectiveness. The different slags were digested in Wagner's acid ammonium citrate, and quite close, though not absolute agreement was observed between the solubility in this reagent and the fertilizing value. It is claimed that with proper precautions this method offers a reliable means of valuing slags.

It has been suggested that it is unnecessary to attempt to reduce the slag to a uniformly fine meal, since the part which resists the grinding is less effective than that which is readily pulverized. To investigate this point the fine meal and coarse meal from the same lot of slag were each reduced to the same fineness and tested in vegetation experiments with a like effectiveness for the two kinds of meal, thus justifying the attempt to reduce all the slag to a uniform degree of fineness.

A "prepared phosphate meal" (fine ground, soft phosphate) offered as a substitute for Thomas slag was tested, with unfavorable results.

The results obtained by the author indicate that bone meal is one of the least effective phosphatic manures, and that where it has produced a good effect the result has often been largely due to the nitrogen which it contains. In order to improve the effectiveness of the phosphoric acid the author treated bone meal with an amount of sulphuric acid just sufficient to transform the phosphoric acid into a condition similar to precipitated phosphate. Experiments with this prepared bone meal gave promising results.

Can difficultly soluble Thomas slag be transformed into readily soluble? P. WAGNER (*Chem. Ztg.*, *18* (*1894*), *No. 79*, *pp. 1511*, *1512*).—There is a wide variation in the solubility of the phosphoric acid in Thomas slag from different sources. The investigations of the author indicate that the higher the percentage of silicic acid the greater the solubility of the phosphoric acid in citrate solution. Hoyermann has reached a similar conclusion.[1] The latter found that by fusing sand with the slag just from the furnace the solubility of the slag in citrate solution was increased from 58 to 84 per cent, but he believes, nevertheless, that the slag which is most active in the soil is that which contains the minimum of silicic acid and the maximum of lime. The author combats this view and summarizes his own conclusions as follows: There are slags which show a solubility in citrate solution of nearly 100 per cent and which are but slightly inferior to superphosphates. The slags of the market vary widely in respect to citrate solubility, ranging from 100 per cent to as low as 40 per cent. The fertilizing value varies in an almost corresponding degree. The principal condition for a high solubility is a certain proportion of silicic acid.

[1] Beitrag zur Frage der Citratlöslichkeit der Phosphorsäure im Thomasschlackenmehl, Hannover, 1894.

If it shall prove that it is comparatively easy to transform a difficultly soluble slag into an easily soluble one simply by increasing the silica content, it will then be important to study what effect this operation has on the fertilizing value of the resulting product.

The chemical constitution of Thomas slag and the determination of its relative effectiveness, P. WAGNER (*Chem. Ztg., 18 (1894), No. 98, pp. 1933–1935, fig. 1*).—The results of analyses and experiments are reported in support of the statement previously made[1] that the richer a slag is in combined silica the more soluble it is in citrate solution and the more active it is in the soil.

Contrary to the opinion of Hoyermann, the analyses show that the solubility in citrate solution does not always increase with the decrease of free lime. They indicate, further, that the silicate and phosphate of lime of the slag are united to form easily decomposable silico-phosphates. Analyses of Rhenish slags of good quality and of the transparent blue crystals found in the cavities of slag show them to contain phosphoric acid and silicic acid in the proportion corresponding to these silico-phosphates (about 42 parts of silicic acid to 100 parts of phosphoric acid). It is to the readily decomposable character of these silico-phosphates and not to the saturation of the free lime by silicic acid, as claimed by Hoyermann, that the solubility of siliceous slags in citrate solution is due.

Vegetation experiments on white mustard gave the following results: Without phosphoric acid, 24.1 gm. of crop; with 0.5 gm. of phosphoric acid in form of superphosphate, 84 gm.; with 0.5 gm. of phosphoric acid in form of Hoyermann's Thomas slag, poor in silicic acid (62 per cent soluble in citrate solution), 62.1 gm.; and 0.5 gm. of phosphoric acid in form of Hoyermann's slag, rich in silicic acid (98 per cent soluble in citrate solution), 84 gm. These results furnish a strong confirmation of the statement that not only the citrate solubility, but also the effectiveness as a fertilizer, of slag increases with an increase of its silicic acid content.

The following is the author's latest revised method for determining citrate-soluble phosphoric acid in Thomas slag and untreated phosphates: Five grams of the slag (as it appears on the market, unground and unsifted) is placed in a 500 cc. flask, 200 cc. of water and 200 cc. of citrate solution (containing 150 gm. of citric acid and 23 gm. of nitrogen, equal to 27.93 gm. NH_3) are added, the flask filled to the mark, and shaken for 30 minutes in a shaking machine making 30 to 40 revolutions per minute. The mixture is filtered at once, and 50 cc. of the filtrate is measured into a beaker, 100 cc. of molybdic solution added, heated to about 80° C. in the water bath, cooled, and filtered. The precipitate is carefully washed with 1 per cent nitric acid and dissolved

[1] Chem. Ztg., 18 (1894), No. 79, pp. 1511, 1512 (E. S. R., 6, p. 624).

in 2 per cent ammonia. To the ammoniacal solution, which should amount to about 100 cc., 15 cc. of magnesia mixture is added, drop by drop, with constant stirring, the beaker covered with a watch glass, and allowed to stand 2 hours. The ammonium-magnesium precipitate is collected on a filter of known ash content, washed with 2 per cent ammonia, dried, incinerated over a Bunsen burner 30 to 40 minutes, and ignited in a Rössler oven for 2 minutes, cooled, and weighed. The method and reagents here recommended are substantially identical with those already described by the author,[1] except that in the method here proposed no account is taken of the basicity of the substance examined.

The fertilizing value of the phosphoric acid of bone, ULBRICHT (*Agr. Chem. Vers. Stat. Dahme; abs. in Chem. Centbl., 1894, II, No. 19, p. 803*).—Experiments in pots in the greenhouse showed that the amounts of available phosphoric acid and perhaps of the other fertilizing constituents naturally present in the soil as well as the other properties of the soil have a very great influence on the action of the phosphoric acid of bone meal. The soils experimented on were partly natural, slightly loamy sand and partly artificial soils, consisting of quartz sand and kaolin. All pots were liberally fertilized with nitrate of soda and potash, one series receiving superphosphate and the other bone. Taking the dry substance produced in pots receiving 0.132 gm. of phosphoric acid as 100, the ratios of production during different years of an equal amount of phosphoric acid in form of superphosphate were as follows:

1890. Light soil, long under culture	110
1891. New soil poor in phosphoric acid	123
1892. Quartz sand and kaolin with trace of P_2O_5	394
1893. Soil freed from phosphoric acid	124

The results indicate that in soils not entirely devoid of phosphoric acid and not of extremely abnormal properties, both steamed and unsteamed bone of proper fineness produced very favorable results, even when applied in the spring, provided the soil was not deficient in moisture. In soils deficient in water very different results were obtained with all kinds of bone meal, but it appeared that the results were more unsatisfactory the coarser the bone.

The water-soluble combinations of phosphoric acid in superphosphates, J. STOKLASA (*Landw. Vers. Stat., 45 (1894), No. 3 and 4, pp. 161–172*).—This is a continuation of work previously reported in the same journal (38 (1891), pp. 197, 401; and 42 (1893), pp. 439–457; E. S. R., 2, pp. 611, 757; 5, p. 520), and relates to the action of calcium carbonate and calcium sulphate in the soil and in superphosphates.

[1]Chem. Ztg., 18 (1894), No. 61, pp. 1153, 1154 (E. S. R., 6, p. 370).

The extent to which calcium carbonate is dissolved in drainage water of different soils is shown in the following table:

Calcium carbonate in 1,000 cc. of drainage water.

	Grams.
Loam soil from gneiss and granite (containing 0.23 per cent CaO, trace CO_2)	0.026
Soil from Silurian slate (3.32 per cent CaO, trace CO_2)	.067
Soil from Dyassic (Permian) sandstone (1.38 per cent CaO, 0.76 per cent CO_2)	.052
Soil from chalk sandstone (3.73 per cent CaO, 2.91 per cent CO_2)	.123
Calcareous plain soil (11.34 per cent CaO, 8.12 per cent CO_2)	.151
Humus soil (1.63 per cent CaO, 1.09 per cent CO_2)	.065

On the basis of these figures it is calculated that the amount of calcium carbonate removed from a hectare of soil annually by the drainage water is 561.6 kg. This carbonate of lime has an important influence on the circulation of fertilizing constituents in the soil. Experiments showed that when $CaH_2(CO_3)_2$, the form which appears in the soil water, was mixed with an equivalent of monocalcium phosphate, $CaH_2(PO_4)_2$, the tricalcium phosphate formed was not precipitated, but was held in solution by the carbonic acid present.

The amount of phosphoric acid appearing in the drainage water of different kinds of soils is shown in the following table:

Phosphoric acid in drainage water of different soils.

		Composition of soil.					Phosphoric acid dissolved in drainage water.	
		Lime.	Phosphoric acid soluble in strong hydrochloric acid.	Phosphoric acid soluble in 2 per cent citric acid.	Carbonic acid.	Humus.	In 100,000 gm. of drainage water.	Per hectare annually.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Grams.*	*Grams.*
(1)	Soil	0.23	0.024	0.0008	Trace.	2.95	0.062	13.492
	Subsoil	.31	.036		Trace.			
(2)	Soil	.59	.087	.0074	Trace.	2.06	.042	9.146
	Subsoil	.63	.125		Trace.			
(3)	Soil	11.34	.226	.0019	8.12	1.63	.070	15.244
(4)	Soil	.23	.008		1	9.56	.101	21.995

The important fact to be observed in this table is that the humus soil, which contained only 0.008 per cent of phosphoric acid soluble in hydrochloric acid, showed decidedly the highest loss of this substance in the drainage. This in a measure confirms the generally accepted view that such soils do not have a high retentive power for phosphates, but readily convert insoluble into soluble forms, which are carried away in the drainage.

It is explained that calcium sulphate is an invariable constituent of superphosphates prepared by treatment of crude phosphate with sulphuric acid. The character and composition of the little balls formed during the preparation of superphosphates are described and illus-

trated. The radiating groups of calcium sulphate crystals formed in a solution of dissolved bone containing *Beggiatoa alba* are also discussed, with illustrations, and various experiments with this organism are described.

Experiments showed that when solutions of monocalcium phosphate or orthophosphoric acid were evaporated to dryness with gypsum the solubility of the phosphate was not affected.

The action of lime and magnesia in marl and burnt lime, ULBRICHT (*Agr. Chem. Vers. Stat. Dahme; abs. in Chem. Centbl., 1894, II, No. 19, p. 803*).—Burnt lime poor in magnesia, heavily applied (710 lbs. per acre), decidedly delayed the ripening of oats, while a similar application of gray lime produced much less marked results. This difference is ascribed to the high percentage of magnesia in connection with lime in the gray lime. Caustic magnesia (burnt magnesite), as well as magnesium carbonate, had a highly injurious effect on oat plants, proving actually poisonous in large amounts.

This injurious effect was not always prevented by simultaneous applications of caustic lime or calcium carbonate. Barley was more resistant to the injurious action of the magnesia than oats.

The relative fertilizing value of the nitrogen in alfalfa and in stable manure, J. KÜHN (*Deut. landw. Presse, 21 (1894), No. 98, pp. 26, 27*).—In pot experiments the author compared the fertilizing value of young alfalfa and of stable manure produced by feeding the same quality of alfalfa to a steer. The steer was kept on a maintenance ration, neither increasing nor decreasing in weight. After being fed for a number of days on alfalfa alone the solid and liquid manure was saved separately and analyzed. The solid and liquid excrement was used in the proportions produced; 185.95 gm. of solid excrement, containing 0.361 per cent of nitrogen and 250 gm. of urine containing 1.38 per cent of nitrogen, were used on each pot of the manure series, the total nitrogen supplied to each pot being 4.1168 gm.

Each of the pots of the green-manure series received 4.1168 gm. of nitrogen in the form of 565.5 gm. of green alfalfa not yet in bloom. This was applied at the rate of nearly 18,000 lbs. per acre, and supplied nearly 130 lbs. of nitrogen per acre, the same rate at which the nitrogen of stable manure was employed.

Another series of pots received each the same quantity of nitrogen (4.1168 gm.) in the form of sulphate of ammonia, supplemented by phosphatic and potassic fertilizers, supplying 49 lbs. of phosphoric acid and 70 lbs. of potash per acre. These last-mentioned fertilizers were intended to offset the phosphoric acid and potash in the green alfalfa and in the stable manure.

These minerals were also applied to another series of pots receiving no nitrogen.

Mustard was planted July 5 and harvested August 13. The follow-

ing table gives the yield per pot in green mustard, dry matter, and nitrogen:

Yield of mustard in pots fertilized with different forms of nitrogen.

	Green mustard.	Dry matter.	Nitrogen.
	Grams.	*Grams.*	*Grams.*
Minerals, no nitrogen	1,164.0	124.5	3.304
Green alfalfa	1,504.0	147.8	4.519
Stable manure	1,606.0	154.9	5.277
Sulphate of ammonia and minerals	1,627.5	148.2	5.362

Comparing the amount of green mustard produced on the nitrogen pots with that on the pots receiving no nitrogen, there is found an increase of 463.5 gm. for sulphate of ammonia, 442 gm. for stable manure, and 340 gm. for green manure. This is equivalent to saying that the nitrogen of stable manure was 95 per cent and that of young alfalfa 73 per cent as effective as that of sulphate of ammonia.

Comparing the amount of nitrogen in the mustard growing on the nitrogen pots with that on the pots receiving no nitrogen, we find an excess of 2.058 gm. for sulphate of ammonia, 1.973 gm. for stable manure, and 1.215 gm. for green manure.

Comparing this excess with the amount of nitrogen applied (4.1168 gm. to each pot) it appears that 50 per cent of the nitrogen in sulphate of ammonia, 48 per cent of that in stable manure, and 30 per cent of that in green alfalfa was utilized by mustard in its 6 weeks of growth.

The nitrogen of stable manure was more immediately available in the author's experiments than in those of previous investigators, a fact which he ascribes to his having used the manure with its full complement of urine as soon as it came from the animal.

The losses of nitrogen in barnyard manure and their prevention, J. Stoklasa (*Oesterr. ungar. Ztschr. Zuckerind. und Landw.*, *23*, *pp. 525–536; abs. in Chem. Centbl.*, *45* (*1894*), *II*, *No. 19*, *p. 800*).—The author undertook to study the chemical processes involved in these losses. It was found that urea did not decompose when dissolved in pure sterilized water and air was excluded or only sterilized air admitted. Inorganic acids completely prevented decomposition. Organic acids (citric, tartaric, and malic) to the extent of 1 to 3 per cent promoted decomposition. Cattle urine, after 60 days of alkaline fermentation, showed a loss of 56.7 per cent of its original nitrogen.

Nitrification under normal conditions in urine from different sources was also studied. Nitrates were observed in urine within 3 days. Calcium sulphate did not appear to promote nitrification. Nitrates did not appear in a solution of pure urea until 3 cc. of urine was added. Nitrites were also observed resulting probably from the decomposition of amids. Investigations of the action of monocalcium phosphate and orthophosphoric acid on ammonium carbonate showed that diammonium phosphate was the result of the reaction.

The use of superphosphate for fixing ammonia in manure and urine is condemned on account both of its feeble power in this respect and the reversion of its soluble phosphoric acid.

Analyes of seaweeds, F. W. TOMS (*Ann. Rpt. Official Analyst of Island of Jersey for the year ending March 25, 1892, pp. 17–21*).—In view of the importance of seaweeds to the agriculture of this island, detailed analyses were made of the following species: Knobbed vraic (*Fucus nodosus*), twin-bladder vraic (*F. vesiculosus*), serrated or boat vraic, and common or fingered colley (*Laminaria digitata*). The results reported are the averages of analyses of fresh weeds, dry weeds, and pure ash from samples collected in March, May, August, and October. The proportion of valuable constituents was lower in autumn and higher in spring than the average. The samples collected in summer gave the highest proportions of potash and the lowest of nitrogen. "The deep seaweeds (colleys) are particularly rich in soluble potash salts, but the 'cut weeds' growing near the shore contain less potash but more soda compounds." The proportions of the more important constituents vary within the following limits: Water, 75 to 82 per cent; nitrogen, 0.25 to 0.3; potash, 0.5 to 1.5; phosphoric acid, 0.1 to 0.13, or 4 to 5 per cent of ash constituents according to the variety.

Inspection of fertilizers, W. H. JORDAN, J. M. BARTLETT, and L. H. MERRILL (*Maine Sta. Bul. 14, 2d ser., pp. 18*).—This bulletin gives a schedule of trade values with notes on valuation and tabulated analyses of 4 samples of fertilizers furnished by the manufacturers, and 60 collected by the station under the provisions of the new fertilizer law. A comparison of the manufacturers' minimum guarantees and the actual composition of both the samples sent to the station by the manufacturers and those selected in the open market by the station shows that "on the average the samples selected by the station were about 5 per cent poorer in nitrogen, 2 per cent poorer in phosphoric acid, and 10 per cent poorer in potash than those sent to the station by the manufacturers. . . . "It is not easy to explain why in 36 cases out of 51 the station samples selected by the station in the markets should fall so much below the manufacturers' sample in the percentage of potash soluble in water," but it has been suggested "that potash in mixed fertilizers disappears to some extent from soluble forms. . . . No facts are at hand to support or discredit this view.

"In general it may said that the analyses of manufacturers' samples . . . were in a majority of cases a fairly safe representation of the goods that were sampled in the market, excepting the somewhat remarkable deficit in potash."

Fertilizers, G. C. WATSON (*New York Cornell Sta. Rpt. 1893, pp. 96–98*).—A reprint from Bulletin 52 of the station (E. S. R., 4, p. 903).

On what class of soils, to what crops, and in what form shall potash fertilizers be applied? III, SCHULTZE (*Braunschw. landw. Ztg., 62 (1894), No. 51, pp. 213, 214*).

Keeping up our lands, I. P. ROBERTS (*Cult. and Country Gent., 1895, Feb. 7, p. 103*).

The production of manure, G. C. WATSON (*New York Cornell Sta. Rpt. 1893, pp. 173–190*).—A reprint of Bulletin 65 of the station (E. S. R., 5, p. 387).

Handling stable manure, W. L. ANDERSON (*Amer. Agr.* (*middle ed.*), *1895, Feb. 9, p. 141*).—Recommends allowing manure to remain under animals until hauled to the fields, when it is spread at once thickly on the land. Three hundred cords yearly are handled in this way. Composting is condemned.

Applying barnyard manure, H. S. MATTERSON (*Cult. and Country Gent., 1895, Feb. 7, p. 104*).—Experiments are reported which indicate that by spreading manure fresh from the stable on the soil growth of weeds is increased. The method of management of the manure is described.

A handy manure box, C. A. ALLEN (*Amer. Agr.* (*middle ed.*), *1895, Feb. 9, p. 141, fig. 1*).

The rational application of bone meal, M. ULLMAN (*Fühling's Landw. Ztg., 43* (*1894*), *No. 24, pp. 766–768*).—General statements relative to the character of soil on which bone meal can generally be advantageously applied.

Natural phosphate of alumina and the adulteration of slag and phosphatic fertilizers, L. GRANDEAU (*Jour. Agr. Prat., 59* (*1895*), *No. 1, pp. 11, 12*).—Wagner's method for detecting phosphate of alumina is recommended. The citrate used in this method contains 5 per cent of citric acid.

Is it certain that the "citrate solubility" of Thomas slag is a measure of its agricultural value? P. WAGNER (*Deut. landw. Presse, 21* (*1894*), *No. 102, pp. 983, 984*).—The essential points in this article are discussed in other articles noticed above (p. 625).

How to apply soda salts, A. H. WARD (*Cult. and Country Gent., 1895, Feb. 7, p. 105*).

Fertilizer analyses and valuation, C. A. GOESSMANN (*Massachusetts State Sta. Bul. 56, pp. 2, 3, 8*).—A schedule of trade values and tabulated analyses of 19 samples of fertilizing chemicals, including muriate of potash, sulphate of potash, nitrate of soda, sulphate of ammonia, and dried blood.

FIELD CROPS.

Alfalfa, F. D. COBURN (*Rpt. Kansas State Bd. Agr., Nov., 1894, pp. 230*).—This publication consists of papers on alfalfa by growers in California, Colorado, Kansas, Montana, Nebraska, Oregon, Washington, Idaho, Wyoming, Arizona, New Mexico, and Utah, in answer to a circular of inquiry. The most important subjects treated in the papers are the following: Character of soil and subsoil; preparation of the land; time, thickness, and manner of sowing; liability of alfalfa to winterkilling, or exemption from this trouble; irrigation, harvesting, and yield; methods of handling the crop for hay and for seed; machines for thrashing alfalfa for seed; cost of growing and baling alfalfa hay; prices of hay and seed; value of alfalfa as a food for swine, horses, sheep, and cattle; duration of an alfalfa meadow; and the value of alfalfa for green manuring.

Canaigre, its cultivation and preparation for market, F. A. GULLEY (*Agl. Sci., 8* (*1894*), *No. 6–9, pp. 320–328*).—The methods pursued in the manufacture of cañaigre tannin extract at a New Mexico factory are briefly outlined. This factory turns out a heavy semiliquid cañaigre extract which contains 45 per cent of tannin material and is so thick that it can be shipped in packages made of inch boards. Its selling price in Chicago and New York is 4½ and 5 cts. per pound. The leach

system of extracting is pursued, the preliminary drying of the roots requiring 2 to 3 days. In the laboratory it was found possible to obtain by diffusion from the fresh roots, grated, a liquid extract in 4 hours. The cost of a diffusion factory, with a capacity to handle 10 tons of cañaigre roots per hour, is estimated at from $100,000 to $125,000. The cost of growing the roots for 1 ton of extract and of manufacturing the same is estimated at $25 per ton of extract containing 55 to 60 per cent of tannin material.

Time of seeding crimson clover, E. B. VOORHEES (*Agl. Sci.*, *8* (*1894*), *No. 6–9*, *pp. 298–302*).—In experiments in New Jersey it was found that where the soil was not reasonably good it was necessary, in order to secure a good stand, to delay sowing until September. On poor soils excellent crops were secured when the seed was sown even as late as October. For good lands the author recommends that seed be sown between July 15 and September 15. It was found that in New Jersey spring seeding either alone or with oats gave disappointing results.

Studies on oats and barley, VON LIEBENBERG (*Mitt. Ver. Förd. landw. Versuchsw. Oesterr.*, *9* (*1894*), *No. 1*, *pp. 54–59*).—When in the spring a mixture of barley and oats was sown the yield of grain was greater than that of oats sown alone.

When seeding was done in such a manner as to leave plants of oats and barley in alternate hills, the barley plants so grown tillered more abundantly than on plats where only barley was grown, notwithstanding the fact that the space allotted to each oat or barley plant was the same on all plats.

The oat plants grown in alternation with barley plants tillered less abundantly than oat plants grown alone. The author attributes these results to the fact that barley stooled earlier than oats, and thus in the mixture prevented the full development of the oat plant.

From his experiments on barley the author concludes that the longer straws bear longer and heavier ears, with a greater number and heavier grains. With oats the longer straws bore longer panicles and a greater number of grains than the shorter straws.

Culture experiments with Irish potatoes, W. M. MUNSON (*Maine Sta. Bul. 12*, *2d ser.*, *pp. 4*).—With 3 varieties a comparison was made between the Rural New Yorker trench system and ordinary culture. Alternate rows were "trenched," that is, plowed about a foot wide and 8 in. deep, the soil in the bottom of the furrow being afterwards pulverized and some of the earth being worked back into the furrow. The seed pieces were covered to a depth of about 2 in., and then a complete fertilizer was scattered in the trenches, which were then filled. Alternate rows were simply plowed, the pieces dropped and covered, and the fertilizer scattered on the surface. The results are conflicting.

Rape as a forage plant, C. D. SMITH and F. B. MUMFORD (*Michigan Sta. Bul. 114*, *pp. 29–34*).—The author emphasizes the importance of

securing true Dwarf Essex seed, as this is the variety which has been found to be most valuable. Rape seed was sown at different dates in June and July and the result favored sowing about July 1. Drilling was preferred to sowing broadcast, since the former method saved seed, allowed easy cultivation, and suffered less loss from cattle tramping and lying on the crop. One acre of rape afforded pasturage for 9 lambs for 7 weeks and produced a total gain of 202½ lbs., or 22½ lbs. per lamb. It was not found practicable to pasture rape later than November 15. The animals pastured on this plant after it became frosted were subject to digestive disorders. Animals should be well fed on dry food before being turned into a field of rape. The cost of labor in planting and growing 15 acres of rape on the station farm was $42.25.

Effects of different fertilizing elements on the composition and combustibility of tobacco, H. J. PATTERSON (*Agl. Sci., 8 (1894), No. 6–9, pp. 329–352, dgm. 1*).—Conclusions of foreign investigators are cited and the experiments made by the author and previously published[1] are tabulated and discussed. The author also gives the ratio of chlorin to potash in the ash of the principal species of wood growing in tobacco sections and in the principal cultivated plants from the same regions. He finds that broom sedge and old field pine contain a relatively large proportion of chlorin, and hence he justifies the practice of allowing old tobacco fields to grow up in sedge and pine, the implication being that these plants remove a large portion of the chlorin, which is believed to have an unfavorable effect on the combustibility of tobacco.

Studies on wheat, VON LIEBENBERG (*Mitt. Ver. Förd. landw. Versuchsw. Oesterr., 7 (1892), No. 1, pp. 59–86; abs. in Centbl. agr. Chem., 23 (1894), No. 11, pp. 748–752*).—By planting summer wheat at different distances, and by giving to the different plats different manures, moisture conditions, and seeds of different sizes, the character of the growth was made to vary considerably.

The longer the straw the longer and heavier was the ear; the longer and heavier the ear the greater the number of grains borne upon it and the heavier the individual grains.

The conditions for the production of sweet and sour silage, A. B. GRIFFITHS (*Chem. News, 70 (1894), No. 1828, pp. 273–275*).—Acid silage, which is produced when the fermentation proceeds at a temperature below 49° C., is divided into two kinds, (1) low-temperature acid silage, in which the temperature has not risen above 32° C., and (2) high-temperature acid silage, in which fermentation proceeds at temperatures of 32 to 49° C.

In the former the principal germ isolated was the acetic-acid ferment. In high-temperature acid silage the germs found were the acetic-acid ferment, the lactic-acid ferment, the butyric-acid ferment, and *Bacillus subtilis*.

[1] Maryland Sta. Bul. 26 (E. S. R., 6, p. 209).

Between 49 and 55° C. layers of sweet and acid silage were intermingled, and at these temperatures the organisms isolated were the lactic and butyric acid ferments, and 2 new species for which the author proposes the names *Bacillus valericus* and *B. thermicus*. When the temperature exceeded 56° C. sweet silage was produced.

When the temperature of fermentation is 60 to 70° C. the author states that the acetic, lactic, and butyric acid ferments are killed or become inactive, giving place to *Bacillus valericus* and *B. thermicus*.

Bacillus valericus is so named because in a sterilized decoction of green fodder at 56° C. it gives rise to small quantities of valeric acid. It is readily stained with a solution of methyl violet.

Bacillus thermicus is so named because of the high temperature at which it thrives. Both *Bacillus valericus* and *B. thermicus* have the power of converting starch into glucose.

With silage produced by fermentation at a temperature below 32° C. the percentage of volatile acids (chiefly acetic, but with traces of formic and butyric acid) was 1.56 for silage from very immature fodder and 0.62 for silage from plants just in bloom. The non-volatile acids (chiefly lactic acid) were 0.10 and 0.9 per cent, respectively, for the abovementioned samples of silage.

With acid silage produced at temperatures of 32 to 49° C. the volatile acids were: From very immature forage, 1.19 per cent; from plants just in bloom, 0.38 per cent. The non-volatile acids were, respectively, 0.31 and 0.23 per cent. The silage was more acid from immature than from older plants.

Sweet silage produced at a temperature of 56 to 70° C. contained only 0.06 per cent of volatile acid and 0.02 per cent of non-volatile acid. When made from plants just in bloom it contained 4 per cent of sugar and other soluble carbohydrates, as against 2.81 and 2.93 per cent contained in acid silage (from plants of same stage of maturity) produced at a temperature below 49° C.

The author states that sweet silage quickly becomes moldy on exposure to air, while acid silage is relatively resistant to decay.

The barley crop of 1894, F. SCHWACKHÖFFER (*Chem. Ztg., 18 (1894), No. 96, Repert., p. 295*).—The chemical and physical properties of the barley crop of 1894 and its value for malt.

Cultivation of licorice root in the United States, F. HOFFMAN (*Amer. Jour. Pharm., 67 (1895), No. 2, pp. 72–77*).

Notes on Polygonum sachalinense, DOUMET-ADANSON and H. VILMORIN (*Bul. Soc. Bot. France, 40 (1893), 2d ser., No. 3, p. CLXXXVIII*).—The authors presented specimens of the true species for which *P. sieboldi* is often confused. The value of the plant for forage is pointed out.

The chemical composition of hay from Chrysopogon gryllus, U. PETRI (*Staz. Sper. Agr. Ital., 27 (1894), No. 4, pp. 369–375*).

The flat pea (Lathyrus sylvestris) (*Fühling's landw. Ztg., 43 (1894), No. 24, pp. 759–766*).—Notes from growers on the palatability of this plant.

Variety tests of potatoes, W. BECKER (*Deut. landw. Presse, 22 (1895), No. 2, p. 13*).

Size and amount of potatoes used for seed purposes, M. MONTARINI (*Staz. Sper. Agr. Ital., 27 (1894), No. 3, pp. 227–250*).

Tests of varieties of rye, N. Westermeier (*Deut. landw. Presse, 21 (1894), No. 101, pp. 973, 974*).

Wheat, barley, oats, peas, and forage plants, E. R. Lake (*Washington Sta. Bul. 10, pp. 19–24*).—Brief notes on 6 varieties of wheat, 5 of barley, 6 of oats, 29 of peas, and on alsike clover, orchard grass, and oat grass.

Artificial drying of grain (*Abs. in Deut. landw. Presse, 22 (1895), No. 2, p. 13*).

HORTICULTURE.

Cassava, J. T. Stubbs (*Florida Sta. Bul. 24, p. 25*).—A small plat of cassava was planted at De Funiak Springs substation on sandy land and 600 lbs. of acid phosphate applied per acre. Little cultivation was required, and from 8 to 15 tons of roots were produced per acre. The roots were relished by stock, which seemed to thrive upon the food.

The growth of lettuce as affected by the physical properties of the soil, B. T. Galloway (*Agl. Sci., 8 (1894), No. 6–9, pp. 302–315*).—The soil on which lettuce is grown near Boston produces plants so much larger and more perfect than are grown in many other parts of the country that investigations were undertaken to ascertain if possible the reason of this difference. The Boston lettuce soil was analyzed mechanically, as was also the gneiss soil of Maryland, and the former was found to possess a much greater proportion of sand, while the latter was rich in silt and clay. The daily moisture content of the Boston soil, as judged from samples taken to a depth of 12 in. averaged much greater than that of the Maryland soil, being 27.7 per cent and 16.5 per cent, respectively, in March.

In the experiments 3 different soils were used in a special greenhouse. The first soil was composed of 2 parts drift sand and 1 part greenhouse soil; the second greenhouse soil alone, 1 part gneiss soil, and 2 parts decomposed manure; and the third two thirds Boston soil and one third decomposed manure. On mechanical analysis the 3 soils were found to closely approximate in structure. Each soil was contained in a bed 2 ft. wide, 7 ft. long, and 20 in. deep, and in each bed were set 33 plants, 8 in. apart on the square. In 2 months the plants were pulled, divided into 3 grades, measured, and then weighed. The plants grown on the Boston mixed soil gave the best results, being followed closely by those produced on the sandy soil, while the greenhouse soil gave very inferior plants.

It is concluded that the physical properties of the soil are of the utmost importance in relation to plant growth, and that lettuce requires a soil possessing an abundance of fine gravel, sand, and silt in such a mechanical mixture as to provide sufficient moisture, heat, and air—a condition existing in the Boston soil.

Strawberries, W. J. Green and E. C. Green (*Ohio Sta. Bul. 54, pp. 35–52*).—This bulletin contains cultural notes for strawberries, and also detailed descriptive notes for 63 varieties. It is stated that straw-

berries will grow well on almost any well-drained soil that is free from frost and reasonably fertile, care being taken that it is not infested with white grubs. It is advised to prepare the soil by plowing in the fall, mulching with manure, and in the spring stirring the ground with cultivators and harrows. The spring is preferred as the time for setting out the plants, and for mats they are recommended to be set every 18 in. in 4-ft. rows; while for hills they may be placed 1 ft. apart in 3-ft. rows. Winter protection should be given by mulching with swamp hay. The beds should be renewed every second year. The following varieties are recommended: Bubach, Crescent, Enhance, Greenville, Haverland, Lovett, Muskingum, Parker Earle, and Warfield.

Strawberries, blackberries, and raspberries, S. T. MAYNARD (*Massachusetts Hatch Sta. Bul. 26, pp. 13*).—Descriptive notes and tabulated data on 124 varieties of strawberries, 12 of blackberries, 18 of red and 20 of black raspberries. The yields were affected by a hailstorm and drought, but the relative production was not interfered with. The strawberries were attacked by leaf blight, which was not wholly checked by spraying with Bordeaux mixture.

Fertilizer tests on grapes, A. L. HOLLADAY (*Virginia Sta. Bul. 35, pp. 147–153*).—For 3 years 10 plats of one fifth acre each, planted with Norton grapes, were tested with various fertilizers calculated to provide either single fertilizing elements or different combinations. One plat was left untreated for a check, and one was fertilized with a complete fertilizer. The soil was red clay. The vines were sprayed 5 times every season to avoid interference from fungus diseases. The results show that nitrogen, phosphoric acid, and potash are all required for the best results at this location. Tables are given showing the details of the experiment, which is to be continued.

Tropical fruits in Florida, L. C. WASHBURN (*Florida Sta. Bul. 24, pp. 26–31*).—Seven acres at the Fort Myers substation are devoted to tropical and semitropical fruits. Notes are given on cocoanuts, cahoon palm, sapodilla, mangosteen, mango, mammæ apple, mammæ sapota, cherimoya (*Anona cherimolia*), star apple, Barbados cherry, date palm, Spanish lime (*Melicocca bijuga*), sour sop or ice-cream fruit (*Anona muricata*), bread fruit (*Artocarpus incisa*), melon papaw (*Carica papaya*), cashew nut (*Anacardium occidentale*), tamarind, cacao, guava, catley guava, avocado pear (*Persea gratissima*), bamboo, royal palm, black pepper, Chinese yam, cassava, royal poincianna, sugar apple, loquat, pecan, Otaheite gooseberry, almond, and citrus fruits. Many of the varieties yielded larger and better fruits than are grown in Cuba and other tropical countries, a fact supposed to be due to less excessive rains and the winters giving a season of rest.

Report of horticulturist, J. N. WHITNER (*Florida Sta. Bul. 24, pp. 13–15*).—A brief report on the progress of the horticultural work of the station, the character of the station soil being touched upon, and experi-

ments with and comparative tests of olives, citrus fruits, Japanese persimmons, grapes, strawberries, Logan berry, celery, and cabbages being mentioned.

African legumes, J. DYBOWSKI (*Rev. Hort., 66 (1894), No. 24, pp. 574–576*).—General notes on various African representatives of this order, notably the patata, ignama, taro, peanut, cajan, calladium, and hibiscus.

Ginseng, G. STANTON (*Amer. Gard., 16 (1895), No. 31, p. 23*).—Notes on cultivation.

Mushroom raising in stables (*Braunschw. landw. Ztg.; abs. in Landw. Wochenbl. Schles. Holst., 44 (1894), No. 41, p. 572*).—Advises growing mushrooms in horse stables, where it is thought the ammoniacal atmosphere will be of value.

The forcing of melons in Paris, G. ALLUARD (*Rev. Hort., 66 (1894), No. 23, pp. 553–556, figs. 6*).—Detailed directions for the early growing of muskmelons in greenhouses, after the methods practiced by Paris gardeners.

Some salad potatoes, G. ALLUARD (*Rev. Hort., 66 (1894), No. 24, pp. 576, 577, figs. 4*).—Illustrated remarks on some varieties of potatoes that in France are especially preferred for salad purposes.

Greenhouse notes, L. H. BAILEY (*New York Cornell Sta. Rpt. 1893, pp. 145–172, dgms. 2*).—A reprint of Bulletin 55 of the station (E. S. R., 5, pp. 294 and 296).

Raspberry cultivation, R. B. WHYTE (*Ontario Fruit Growers' Assn. Rpt. 1893, pp. 51–54*).—Notes on the culture of raspberries in Ontario. It is advised that the canes be planted in the fall in a heavy sandy loam and covered during the winter. Fall pruning is preferred. The varieties recommended are Cuthbert, Herstine, Heebner, Golden Queen, Brinckle Orange, Caroline, Hilborn, and Purple Hybrid Shaffer.

Raspberries and blackberries, F. W. CARD (*New York Cornell Sta. Bul. 57, pp. 191–215, figs. 4*).—A reprint of Bulletin 57 of the station (E. S. R., 5, p. 394).

The best berry for wine, L. NATHAN (*Ztschr. landw. Ver. Hessen, 1894, No. 38, pp. 313, 314*).—The American mountain gooseberry is strongly recommended, and tables are given favorably comparing the yield and analysis of its wine with that of currants, blackberries, and strawberries.

The Logan berry, C. H. SHINN (*Garden and Forest, 7 (1894), pp. 465, 466, fig. 1*).—Descriptive notes on this rasp-blackberry cross.

The durian (Durio zibethinus) fruiting in Dominica (*Agl. Jour. Leeward Islands, 1894, Oct., pp. 32–34*).—A description of the edible fruit, so highly prized in portions of Asia, is given.

The botany of the grape, C. E. BESSEY (*Garden and Forest, 8 (1895), pp. 47, 48*).—The author in a paper read before the Nebraska Horticultural Society says that for horticultural purposes only 11 of the 35 or 40 known species of grape need be considered. These are *Vitis labrusca, V. candicans, V. æstivalis, V. cinerea, V. californica, V. rupestris, V. vulpina, V. palmata, V. cordifolia, V. vinifera,* and *V. rotundifolia.*

At what distance is the limit of planting grapevines? (*Prog. Agr. et Vit., 12 (1895), No. 1, pp. 22–24*).

The importance of hybridization for the improvement of vineyards, A. MILLARDET (*Compt. Rend., 119 (1894), No. 26, pp. 1176–1180*).—An article urging more experiments in this line, not only for the bettering of the quality of the grapes but also to find stocks resistant to the phylloxera.

Russian apples, G. BELLAIR (*Rev. Hort., 66 (1894), No. 24, pp. 570, 571*).—Notes on some varieties of this type, with statistics of the varieties grown in various countries.

Four new types of fruits, L. H. BAILEY (*New York Cornell Sta. Rpt. 1893, pp. 53–67*).—A reprint of Bulletin 51 of the station (E. S. R., 4, p. 916).

Small fruits for profit, L. WOOLVERTON (*Ontario Fruit Growers' Assn. Rpt. 1893, pp. 132–136*).—This paper speaks in general of the raising of small fruits and in detail of the strawberry, treating of the fertilization of the blossoms, choice and preparation of soil, planting, manure, cultivation, winter protection, picking, and marketing.

Necessity for a change in our methods of obtaining and introducing new varieties of fruit, T. BEALL (*Ontario Fruit Growers' Assn. Rpt. 1893, pp. 86–88*).—This paper urges greater care in the selection, testing, and recommending of new varieties, and advises that more extensive and scientific work in hybridizing and cross fertilization be undertaken.

Soil preparation for orchards, N. SCHNEIDER (*Rev. Hort., 66 (1894), No. 24, pp. 577–579*).—Directions for plowing, trenching, draining, and seasoning the ground before planting fruit trees.

Manuring of fruit trees, HELD (*Würt. Wochenbl. Landw., 1894, No. 48, p. 655*).—Brief note on the importance, if good yields are expected. Replacing old trees with strong young ones is advised.

Manures and manuring of fruit trees, N. SCHNEIDER (*Rev. Hort., 66 (1894), No. 23, pp. 560–562*).—A general account of the requirements of different soils and fruits and the methods of applying the proper fertilizers.

Manuring fruit trees, and increasing their productiveness (*Ztschr. landw. Ver. Hessen, 1894, No. 28, pp. 228, 229*).

Contributions to the subject of manuring vineyards (*Würt. Wochenbl. Landw., 1894, No. 51, pp. 705, 706*).

Modification of fruits by climate, J. CRAIG (*Ontario Fruit Growers' Assn. Rpt. 1893, pp. 61–63*).—General remarks on the variation of the form, color, and quality of different fruits, apples being chiefly considered. Cool, moist localities produce more elongated fruits than do hotter, drier regions. Each variety is believed to have a particular locality where its highest state of development is reached.

Does mulching retard the maturity of fruits? L. H. BAILEY (*New York Cornell Sta. Rpt. 1893, pp. 249–262, pl. 1*).—A reprint of Bulletin 59 of the station (E. S. R., 5, p. 583).

Electricity and plant growth (*Würt. Wochenbl. Landw., 1894, No 48, pp. 654, 655*).

Electro-horticulture, E. WOLLNY (*Ztschr. landw. Ver. Hessen, 1894, No. 49, pp. 401, 402*).—Brief notes on some experiments with electricity in growing plants.

Transmission of cuttings (*Gard. Chron., 17 (1895), ser. 3, p. 79*).—Directions are given for the proper method of packing for successful transportation.

Carbon dioxid in fruit shipping (*Garden and Forest, 7 (1894), p. 470*).—Brief note on recent experiments.

SEEDS—WEEDS.

The vitality of red clover seed, W. J. BEAL (*Agl. Sci., 8 (1894), No. 6–9, p. 284*).—In 1882 the author saved the seed from 50 heads of red clover from 5 plants growing in as nearly the same conditions as possible. The seed was corked in glass bottles and kept most of the time exposed to the light. In June, 1894, 2 lots of 50 seeds each were taken from each bottle and tested for germination with the following result:

Germination of 12-year-old clover seed.

	June 7.	June 23.
Lot 1	24	21
Lot 2	8	10
Lot 3	34	32
Lot 4	25	21
Lot 5	0	4

The average for both tests is 35.8 per cent.

An examination of lot 5 showed the seeds were of a dull color, giving the impression that they were not properly cured when placed in the bottle, to which fact may be due the low vitality.

The vitality of seeds buried in the soil, W. J. BEAL (*Agl. Sci., 8 (1894), No. 6–9, pp. 283, 284*).—In 1879 the author buried 20 lots of 50 seeds each of 21 species of plants, mostly weeds. The seeds were placed in 8-oz. bottles, mixed with sand and buried at a depth of 20 in., the open mouths of the bottles slanting downward. Sets of these seeds were dug up at the expiration of 5, 10, and 15 years, and tested for their vitality. The last year's test of germination is reported upon as follows: Ragweed, chess, fireweed, spotted spurge, cockle, round mallow, red oak, arbor vitæ, and white clover did not show any germinated seeds; pigweed and broad-leaved plantain, 1 seed each; pigeon grass and chickweed, 3 each; black mustard and smartweed, 4 each; mayweed, 5; evening primrose, 6; narrow dock, 7; purslane, 9; pepper grass, 17; mullein, 18; and shepherd's purse, 21.

The influence of moisture and temperature on the process of germination, W. DETMER (*U. S. Dept. Agr., Weather Bureau Bul. 11, pt. 2, Rpt. Internat. Meteorolog. Congress, 1893, pt. 2, p. 22*).—The author summarizes the results of many years devoted to the study of the germination of seeds, and reviews the physiological phenomena attending germination.

In the process of turgescence, internal as well as external work is performed and heat is liberated.

"[The author] mixed potato starch and pea meal of accurately known temperature with water of the same temperature. A striking increase of temperature followed at once. If potato flour is dried and after cooling brought in contact with water the temperature will rise at once more than 6 degrees. In every imbibition process, therefore, as well as during the turgescence of seeds, there is a condensation of the water which has penetrated between the molecules of organisms, and this must produce a liberation of heat."

[The rise of temperature produced when a liquid penetrates a mass of fine particles is not due to the condensation of the liquid by the particles and the liberation of latent heat by compression, as is maintained by Sachs and most botanists. It is a thermo-dynamic phenomenon consequent on the conversion of a solid mass of water into a great number of thin films, *i. e.*, into a great area of surface, as was first demonstrated by Thomson in 1859 and especially by Van der Mensbrugghe in 1876.[1]] The fact that many individual seeds of the same crop do not easily absorb water and germinate, but in some cases delay this process for months and even years, is shown to have a very important bearing on the perpetuity of the species. Measurements are given of the amount of water absorbed by seeds, the increase of volume, the pressure, and the amount of work done. The seeds of some

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[1] Bul. Belgian Acad., 1876, or L. E. D. Phil. Mag., 1876.

plants may become turgescent and then dried without serious injury to their vitality, but a few varieties are injured, and, in general, drying up is fatal to the seedlings. The author agrees with Wollny that the partial drying up of potato tubers materially increases the productivity of plants grown from them.

With regard to the influence of temperature on germination the author maintains that perfectly dried seeds retain vitality under the lowest attainable temperatures, but that even moderate freezing destroys most of the turgescent seeds. With regard to the action of frost and the freezing of plants he differs entirely with the views advocated by Sachs as to the influence of thawing, and adopts the results of Müller-Thurgau. The cell sap does not freeze, but the purer sap in the intercellular spaces freezes; plants that freeze at —8° C. do not perish until exposed to —20° C. The first effect of frost is to disorganize and destroy the protoplasm of the cells, and the water thus set free exudes from the cells to freeze. High temperatures are resisted by the plants when they are in a dry state almost as well as low temperatures. Well-dried seeds endure 50° C. for a considerable time and 100° C. for a short time without loss of vitality. Turgescent plants are injured by heat, because the chlorophyll pigment is decomposed by organic acids originating with the cellular fluids. The author substantiates Müller-Thurgau's discovery that potato tubers can be made to germinate soon after maturing if they are exposed for one or two months to a temperature of 0° C. or 2° C. in order to accumulate sugar; the potatoes thereby become sweet, and the tubers will quickly germinate. This sweetness is not due to freezing, as was formerly supposed. Such sweetish potatoes may be rendered fit for use again by allowing them to remain for some time in a warm place, as the brisk respiration which takes place rapidly destroys the sugar.—C. ABBE.

Squirrel-tail grass, A. NELSON (*Wyoming Sta. Bul. 19, pp. 73–79, figs. 3, pls. 4*).—Squirrel-tail grass (*Hordeum jubatum*) is commonly known in Wyoming as foxtail. Alkali soils and wet places are most infested with this weed. Squirrel-tail grass in heading forms long barbed awns, and when the plant is mixed with other hay and animals eat the mixture, these awns penetrate the gums, causing ulceration of the jawbones and teeth. This occurs with cattle, sheep, and horses, but most frequently with the latter, as they are most frequently fed on hay. Care should be taken that the seed is not spread by the water used in irrigating. Since the plant is an annual it may be subdued by mowing the field at such intervals as to prevent its seeding for one season. Plates showing the appearance of the plant and of the jawbones of sheep injured by the barbs are given.

Wild, or prickly, lettuce, J. C. ARTHUR (*Indiana Sta. Bul. 52, pp. 83–113, pls. 4, map 1*).—During the past year inquiries relating to the wild or prickly lettuce (*Lactuca scariola*) were so numerous that a bulletin of information was prepared giving a description of the plant, history

of its introduction, and spread. The various characteristics of the plant as a weed are pointed out. It has been estimated that a plant of medium size ripens about 8,256 seeds or fruits, and of this number about 10 per cent are capable of immediate germination, 90 per cent remaining dormant until the following spring, or doubtless some are of longer vitality.

The prickly lettuce is a native of Europe and was introduced into this country about 30 years ago, the first record of its observation being at Cambridge, Massachusetts, in 1863. At the present time it has spread nearly all over the United States, but it seems to find the most congenial domain in the valley between the Alleghany and Rocky mountains between 40 and 43° north latitude. Its introduction into Indiana seems to have been subsequent to 1881, and it is now reported as a pernicious weed in 29 of the 92 counties of the State. The author considers its extermination impracticable, but it may be held in subjugation by mowing and uprooting so as to prevent seeding to as great a degree as possible.

The plant is somewhat interesting from the habit of its stem leaves arranging themselves into vertical position with their edges directed to the north and south. It is one of the two best known of the so-called compass plants.

The text of the Canadian thistle law is quoted and similar legislation urged against this new pest.

Concerning the temperature of germination experiments (*Oesterr. Landw. Wochenbl., 35 (1894), p. 294; Bot. Centbl., 61 (1895), No. 2, pp. 52, 53*).—The author reports the advantage of an intermittent temperature for the germination of grass seeds.

Number of germinative seeds in a pound or bushel of grass and clover seed, W. CARRUTHERS (*Jour. Roy. Agr. Soc. England, 3d ser., 5 (1894), No. 20, pp. 797–799*).

Reports of Skara Chemical and Seed Control Station for 1892 and 1893, O. NYLANDER (*Skara (Sweden), Report for 1892, pp. 28; Report for 1893, pp. 25*).

The Russian thistle in Nebraska, C. E. BESSEY (*Agl. Sci., 8 (1894), No. 6–9, p. 286*).—An account is given of the introduction and spread of this weed in the State, and a report of what precautionary measures have been adopted by the station to prevent its spread.

DISEASES OF PLANTS.

Peach yellows, L. H. BAILEY (*New York Cornell Sta. Bul. 75, pp. 393–408, figs. 7*).—During the past season the author has made a careful study of the peach industry of western New York, and in nearly every region has found the yellows present, and particularly bad in Niagara County, which is in the leading peach section of the State. He found that fruit growers were not always able to distinguish peach yellows from the attack of borers or from growth in orchards which are not cultivated or pruned, and on this account he presents figures and descriptions of the disease in order that it may be more readily distinguished.

The yellows is said to be an incurable disease, attacking peach trees of all ages and conditions of vigor, seeming to have a preference for those which are thrifty. It also attacks apricots, almonds, and Japanese plums. It may be communicated from tree to tree, but the means of communication are not known. Fertilization of the soil it is believed will neither cure nor check the spread of the disease. The author in the summary characterizes the disease as follows:

"The one unmistakable symptom of yellows is the red-spotted character of the fruit. The flesh is commonly marked by red lines or splashes beneath the spots. These peaches generally ripen prematurely, and in the second year they are usually smaller and often more fuzzy than the normal fruit. The second symptom to appear—or the first in trees not in fruit—is the 'tip' growth. This is a short growth starting from the upper or terminal buds, usually late in the season, and is characterized by narrow, stiff, yellowish, small leaves which stand at nearly right angles to the shoot. Sometimes these tips appear late in autumn, after the leaves have fallen, or in spring before normal growth begins. They are often first seen upon the ends of watersprouts. This 'tip' growth is sometimes little pronounced, and then only a practiced eye will detect it.

"The third mark of the disease is the pushing out of slender, stiff-leaved, yellowish shoots from the body of the tree or the sides of the large limbs. In pronounced cases, or when the tree is about to die, these shoots may branch into close bunchy tufts. These symptoms are frequently wholly absent in this state throughout the entire course of the disease.

"In its final stage the disease is marked by small and slender growth of all new wood, small, narrow, yellow, or reddish foliage, and occasionally by a great profusion of slender and branchy growths in the center of the tree.

"As a rule, yellows trees die in five or six years from the first visible attack."

The yellow and stunted condition caused by the peach-tree borer frequently results in growths which are mistaken for peach yellows. The only remedy offered is the extermination of all affected trees, but this will only keep the disease in check. Peach yellows is readily communicated to nursery stock by affected buds, even though the buds may be from trees which do not show any signs of the disease. Pits from affected trees may also be expected to propagate the disease.

The Connecticut laws relating to peach yellows are quoted, and it is recommended that the provisions of these laws should be incorporated in the New York law. The author recommends that public sentiment be aroused in favor of the law, as it will be powerless to prevent the spread of the disease by the enactment of laws unless every one lends his aid to carrying out their provisions.

External characteristics of the chytridiose of the grape, A. PRUNET (*Compt. Rend.*, *119* (*1894*), *No. 19*, *pp. 808–811*).—This disease, which the author has determined as due to *Cladochytrium viticolum*, is one of the most widely spread diseases of the grape. Its external characteristics are as follows: The internodes are more or less shortened, abnormally thickened, twisted and curved, and their surfaces covered to a considerable degree with punctures and spots. The punctures are slightly elevated, conical, irregularly hemispherical or linear, having a diameter of 0.5 to 1 mm. They are frequently arranged in

longitudinal rows, reddish, brown, or black, often slightly depressed at summit, smooth or roughened, most numerous toward the base of the branches. The spots are reddish, brown, or black, often somewhat prominent or sometimes sunken, irregular in size and shape. They often split and become somewhat incrusted. Their distribution is very variable over the branches. At length by their cracking and thickening these spots destroy the adjacent cortex. Sometimes by their abundance and splitting the cavities reach down to the pith. On the upper portions of the branches the fungus accomplishes the defoliation and desiccation of the vine.

The leaves present varying appearances. Sometimes the blade becomes more or less red or yellow. Later it becomes dried, the desiccation appearing at the periphery of the leaf or between the principal veins. At other times the green color persists with a slightly paler color between the veins, or at the circumference, drying up almost immediately, or after the appearance of red, brown, or yellow irregular spots which may sometimes cover the entire leaf. Another aspect of the diseased leaves is the appearance in the green tissue of small, red, brown, or black spots, round or irregular, which by their great number become fused together, drying up the leaf. In addition to these detailed aspects there may be various combinations of them. The spots usually appear on the upper and extend to the lower surface of the leaf, although this order may be reversed. The punctures and spots accompanied by the roughening or slitting may be expected to appear on the petiole and principal veins the same as on the branches. Sometimes the leaves retain their normal size, or are but slightly reduced, are thickened in spots of greater or less extent, and finally fall. Often after defoliation the tips of the branches may also become detached from the vine.

Spots and elevations similar to those seen on leaves and stem may be found on the fruit, producing similar effects and causing even the entire bunch to dry up and fall off.

Chytridiose is as yet not a very severe disease of the grape, although of a grave character, and it may be recognized by the color, the drying up of the leaves, branches, and fruit, and the punctures which appear most abundantly at the base of the shoots while still green and on the fruiting pedicels.

In a later number of the same journal[1] the author contributes some additional facts relating to the biology of this fungus. During the winter the spores become encysted and upon their emergence give out numerous zoöspores, which after germination enter the living wood of the stock, the mycelium penetrating it. Toward the end of the season zoöspores and mycelium are rarely seen, but cysts appear to complete the life cycle. This fungus is a true parasite and does not develop in

[1] Compt. Rend., 119 (1894), No. 26, p. 1233.

dead tissue. It disappears quite rapidly from dying wood and the cysts are never found in the dead portions of the vine.

The use of sulphur and copper has not been very effectual in checking this disease, especially in the case of some of its foliar forms, as the fungus is confined almost wholly to the inner parts of the host. Causes tending to enfeeble the host are greatly exaggerated by this disease, and its attack upon the protoplasm in the inner parts will soon kill the vine.

The treatment recommended, especially for the chlorotic forms of the disease, is the use of iron sulphate placed at the root of the stock, as a wash to be used in autumn and winter, and in 0.5 to 1 per cent solutions as a spray to be applied to the leaves several times during the growing season.

Cladochytrium viticolum is said by the author to produce effects similar to those of phylloxera where it causes discolorations, and on this account it should be considered in investigations relating to resistant stock for grafting.

A disease in the nurseries and plantations of Paris, L. MANGIN (*Compt. Rend., 119* (*1894*), *No. 18, pp. 753–756*).—The author describes an attack of *Nectria cinnabarina* under the name *rouge*, characterized by the red or salmon colored elevations formed under the cortex. It attacks linden, chestnut, maple, elm, locust, and ailanthus trees. The last named has usually been considered free from attack, but the author finds it quite commonly diseased.

Usually considered as a saprophyte, the parasitism of this fungus has been shown by Mayr[1] and verified by the author, who adds facts as to the spore germination. The spores germinate very feebly or not at all in water; sugar solutions are better, but wood infusions are the best to use in cultures. The optimum temperature of germination of the conidia is between 18 and 20° C., and they are very sensitive to light. Sodium naphthalate in 0.0005 per cent solution prevents their germination, while 0.0003 solution of copper sulphate does not affect them. Tannin in solutions of from 0.0025 to 0.004 per cent killed the conidia.

The infection of the trees is largely effected during the moist weather of spring and fall, the hot, dry weather of summer and a low temperature acting unfavorably upon the fungus. The living tissues offer considerable resistance to the entrance of the parasite, and it must gain access through wounds and dead wood. It is only after the mycelium has ramified throughout the tissues and effected their destruction that the fruiting organs are formed. The effect of the fungus on the tissues is rather characteristic. The starch is used up and greenish masses deposited in the cells of the wood, resulting in a kind of gummosis deposit in the vessels. In the cortex all the cellular portions are broken down except the bast fibers. The cork alone resists the attacks of the parasite.

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[1] Untersuchungen aus dem forstbotanisch. Inst. München, vol. 3, pp. 1–14.

Washing or spraying will be found ineffectual, as the mycelium has been traced 60 cm. from the place where the organs of fructification are shown. The only treatment is to prevent the spores from gaining access to wounds and dead wood. For this purpose the wounds should be covered by some impermeable coating, such as coal tar or a mixture of linseed oil, zinc oxid, and lampblack. The antiseptics mentioned above, tannin and sodium naphthalate, may be first used as a wash before applying the coating.

Weather vs. injurious fungi, B. D. HALSTED (*Agl. Sci.*, 8 (*1894*), *No. 6–9*, *pp. 292–297*).—The author considers the relation between the weather and the twig blight of fruit trees due to *Bacillus amylovorus* and a blight of potatoes due to a *Vermicularia*.

The twig blight had never been known as prevalent in New Jersey as during the past year. It appears that warm, moist weather is conducive of rapid development of the parts of the plant attacked by the fungus and the conditions are offered for a rapid multiplication of the germs within the tender parts of the host. "If this supposition is rational it goes without further discussion that fire blight, while not caused by the weather, is a creature largely of moisture and heat when they come in excess while the fruit trees are unfolding their buds highly charged with the rich elements of stored-up plant food."

The author thinks that with a knowledge of the relation between weather and fungus development some method of treatment may be found to prevent the blight.

In the case of the potato blight the vines fail to make normal growth, and when about half sized the leaves begin to turn brown and finally the stems fall to the ground. The crop of tubers will be small and scarcely worth harvesting. The trouble is usually located near the ground but in bad cases it covers the whole plant, and the fungus causing it thrives under conditions of abundant moisture and warmth. Too much rain will prove injurious to the plants, causing a greatly weakened condition and fitting them for the attacks of a fungus not otherwise capable of serious injury to the potato. In this case weather has a very important part in preparing the host for the fungus, and a study of the relation between the two may result in the discovery of the proper time for preventive application of fungicides.

The most important factor in the development of rust, L. H. PAMMEL (*Agl. Sci.*, 8 (*1894*), *No. 6–9*, *pp. 287–291*).—Of the more important factors potent in causing rust development, namely, climate, character of soil, especially its fertility, and variety of host, the author considers the climate as the most important. Meteorological tables are given showing the rainfall at Ames, Iowa, for the months of May, June, and July, 1890–'94, from which it is shown that the amount of rust and precipitation are very closely related, being worse during the years of greatest rainfall. In 1894, when the rainfall was very small, the absence of all fungi was very general.

A new parasite of sugar beets, L. TRABUT (*Rev. gén. Bot., 6 (1894), No. 70, pp. 409, 410, pl. 1*).—The sugar beets in the experimental fields of the agricultural school at Romba presented in May of the past year a great number of tuberosities due to a fungus. They usually appeared at the insertion of the first leaves and formed a complete circle underneath the leaves, equaling in weight the beet root itself. The surface, at first greenish-yellow, became gray or nearly black, and finally lobed and tubercled. If a section be made of one of the attacked tubercles a watery parenchyma may be seen, with here and there running through it some irregular fibrovascular bundles. Numerous dark areas will be observed, the masses of spores. Some plants may be affected and not show the swollen places, but the nutrition will be interfered with and under different circumstances the tubercles may be developed.

No reference is given to any trials having been made for the suppression of the disease.

The author presented a note[1] on this fungus under the name of *Entyloma lephroideum*, a species of *Ustilagineæ*, but Saccardo, to whom specimens were submitted, decided it was not an *Entyloma*, but differed from it by the swollen spore-bearing terminal branches, and he proposed for it the generic name *Œdomyces*, characterized as follows: Mycelium, intercellular, filaments very slender. The spore-bearing branches bear a terminal spore or swollen vesicle. Spores, rarely solitary, more frequently grouped in great numbers in the alveoli. Epispores, swollen, brown, smooth. Promycelium and sporidia not seen. According to this determination the species becomes *Œdomyces lephroides*, described as follows: Swellings, fleshy, very large, developed at the expense of the leaves or buds, lobed, showing in section a white parenchyma with numerous black spots composed of single spores or masses of them, most frequently grouped together, borne upon very slender and at length swollen branches. Vesicles spherical or slightly flattened, with a short pedicle inserted in the center of the depressed face. Epispores swollen, smooth, brown, 35 μ in diameter.

Report of botanist and entomologist (*Florida Sta. Bul. 24, pp. 16–19, fig. 1*).—The author reports preliminary experiments with Bordeaux mixture and ammoniacal copper carbonate for eggplant blight. The leaf-spot fungus (*Phyllosticta hortorum*) was also present. A report is also made on the successful use of Bordeaux mixture and eau celeste for the shot-hole fungus of plums. Par Oïdium, used for the same disease, was without effect.

While testing some tobacco seed it was found that some of the seedlings were infested by nematodes (*Heterodera radicicola*,) causing their destruction in a few days. The seedling is attacked as soon as sprouted, or shortly afterwards, the radicle assumes a greatly swollen

[1] Compt. Rend., 118 (1894), No. 23, pp. 1288, 1289 (E. S. R., 6, p. 147).

shape, the cotyledons are arrested in their development and the caulicle fails to appear. The seed bed was made from sand taken from a field and kept in an air-dried condition for 10 months prior to the time of its use in the test. From this it is evident that care should be exercised in selecting soil for seed beds, old land being very liable to be infested.

Paris green and London purple were applied very successfully to plum and peach trees for the curculio.

Variability in the spores of Uredo polypodii, B. M. DUGGAR (*Proc. Amer. Acad., 1894, pp. 396–400, figs. 15*).

The homologies of the Uredineæ, C. E. BESSEY (*Amer. Nat., 28 (1894), pp. 989–996*).

History of the development of the æcidia and spermagonia of the Uredineæ, R. NEUMAN (*Hedwigia, 33 (1894), No. 6, pp. 346–361, pls. 4*).

Concerning the special parasitism of grain rusts, J. ERIKSSON (*Ber. deut. bot. Ges., 12 (1894), No. 9, pp. 292–330*).

Concerning brunissure, J. PASTRE (*Prog. Agr. et Vit., 12 (1895), No. 1, pp. 17–19*).—A controversial article.

Apple canker, C. W. H. GREAVES (*Gard. Chron., 17 (1895), ser. 3, p. 72*).—A description of the attack of *Nectaria ditissima* is given and the use of solution of iron sulphate or of ammoniacal copper carbonate is advised.

A fungus disease (Hormodendron hordei) of barley (*Fühling's landw. Ztg., 44 (1895), No. 1, pp. 28, 29*).—A brief note on the subject.

The appearance of a root disease (Leptosphæria circinans) of lucern in Bavaria, F. WAGNER (*Ztschr. landw. Ver. Bayern, 84 (1894), Sept. and Oct., pp. 774–789, tables 4*).

A disease of wood vetches, E. BINDER (*Tirol. landw. Blätter, 13 (1894), No. 23, pp. 201, 202*).

Leaf spot of orchids (*Gard. Chron., 17 (1895), ser. 3, pp. 70, 71*).—A fungus disease is described, and the use of a dilute solution of copper sulphate as a fungicide is advised. All badly diseased leaves should be removed and burned.

Soaking seed barley in fungicide solutions, HOLLRUNG (*Braunschw. landw. Ztg., 62 (1894), No. 51, pp. 214, 215*).

Treatment of club root of cabbage, SELTENSPERGER (*Prog. Agr. et Vit., 12 (1895), No. 1, pp. 20, 21*).—The application of quicklime to soil is advised as a preventive measure.

Œdema of the tomato, G. F. ATKINSON (*New York Cornell Sta. Rpt. 1893, pp. 99–128, pls. 8*).—A reprint of Bulletin 53 of the station (E. S. R., 5, p. 55).

The spraying of orchards, E. G. LODEMAN (*New York Cornell Sta. Rpt. 1893, pp. 263–302, figs. 4, dgms. 2*).—A reprint of Bulletin 60 of the station (E. S. R., 5, p. 683).

Treatment of anthracnose by sulphuric acid, L. DEGRULLY (*Prog. Agr. et Vit., 12 (1895), No. 2, pp. 29–31*).

Notes on the chemistry of the copper salt fungicides, F. T. SHUTT (*Ontario Fruit Growers' Assn. Rpt. 1893, pp. 77–79*).—Chemical notes on the preparation, composition, and action of Bordeaux mixture, eau celeste, copper carbonate, and ammoniacal copper carbonate.

The systematic differences between various related parasitic fungi and the basis of their biological relations, P. MAGNUS (*Hedwigia, 33 (1894), No. 6, pp. 362–366*).

A mycological flora of Montpellier, G. BOYER and A. DE JACZEWSKI (*Bul. Soc. Bot. France, 40 (1893), 2d ser., No. 3, pp. CCLX–CCXCVIII, figs. 12*).—A list of species with critical notes and descriptions of new species.

Legislation against plant pests (*Garden and Forest, 8 (1895), pp. 41, 42*).

ENTOMOLOGY.

Insects of the clover field, G. C. DAVIS (*Michigan Sta. Bul. 116, pp. 41–64, figs. 11, pl. 1*).

Synopsis.—This bulletin consists of 2 parts, the first dealing with insects destructive to clover, comprising 4 species attacking respectively the root, leaf, seed, and hay; and the second giving brief notes on 8 species that are designated as common but not destructive.

Insects destructive to clover (pp. 41–58).—Illustrated notes on the appearance, life history, ravages, and treatment of the clover-root borer (*Hylastes obscurus*), clover-leaf weevil (*Phytonomus punctatus*), clover-seed midge (*Cecidomyia leguminicola*), and clover-hay worm (*Pyralis costalis*). The clover-root borer made its appearance in the State in 1889 and rapidly spread over the middle and southern portions, extending west to Lake Michigan. The greater destruction has been in the southern part, its progress being slower toward the north owing to the sandy forest regions. A map is given showing its distribution in the State. Investigations show that the imagoes first appear early in May, and the latter part of the month begin depositing their eggs in the galleries bored in the clover roots where they have hibernated. The larvæ begin to pupate about July, issuing as adults in the fall and passing the winter in that state. Red clover and mammoth clover suffer most severely, although alsike is also attacked. White clover seems to be exempt. The plants are rarely attacked until they are a year old. Experiments with nitrate of soda, muriate of potash, and kainit, applying them at the rate of half a ton and a ton per acre, were made, but the beetles were apparently unaffected, while the plants were seriously injured and some of them killed. Plowing under in the spring of the second year, or plowing in the summer and thus exposing the roots and young larvæ to the sun, are suggested as the only remedies at present known.

The clover-leaf weevil is found in all parts of the State except the northern, and has done considerable damage. This season the pest was destroyed in great numbers by a fungus disease (*Empusa sphærosperma*). This rapidly killed the larvæ, which before dying crawled up blades of grass and coiled themselves around the tips. In one instance, cattle feeding upon such grass were rendered sick, though no serious result ensued. A report on this fungus attack, by C. F. Wheeler, is included.

The clover-seed midge is considered the most dangerous enemy of the clover crop in the State, the flies depositing their eggs over the clover head before the florets open, and the maggots crawling into the flower tubes and making their way into the forming seed. The eggs for the first brood are laid in May, and for the second in July. Mammoth and common red clover are most attacked, alsike not being molested. Pasturing clover fields through the spring and early sum-

mer is recommended, or early cutting of the crop before the larvæ of the first brood have matured and dropped from the seeds to the ground to pupate.

The clover-hay worm is found only in dry clover hay, the eggs being deposited in June and the larvæ feeding throughout the rest of the year, and changing into moths the following spring. Clean mowing is advised and never storing clover hay 2 seasons in the same mow. Where hay is attacked, bisulphid of carbon may be applied, 3 or 4 lbs. to each ton, and the hay covered with heavy blankets for a few days.

Insects that are common but not destructive (pp. 58–64).—This part of the bulletin comprises illustrated descriptive, life history, and remedial notes on the following insects: Clover-root mealy bug (*Dactylopius trifolii*), clover-stem borer (*Languria mozardi*), common yellow butterfly (*Colias philodice*), clover drasteria (*Drasteria erechtea*), clover-head caterpillar (*Grapholitha interstinctana*), clover-head thrip (*Phlœothrips niger*), and the white-winged fly (*Bibio albipennis*).

The scale insect of mulberry trees, C. SASAKI (*College of Agr., Tokyo, Japan, Bul., vol. 2, No. 3, pp. 107–124, pls. 2*).—Illustrated descriptive and life-history notes on a scale insect of importance to the silk industry in the East, and which is technically described as a new species (*Diaspis patelliformis*).

The male is orange red, with yellow appendages, and 0.8 mm. long by 0.25 mm. broad. The wing expanse is 2 mm. The female is oval, light yellow, and possesses 9 segments, the third to the ninth being margined with a number of minute fine spines, simple or branched. There are two broods, the adults appearing in June and October, and the males dying soon afterwards, while the females of the second brood live through the winter on the mulberry bark. The larvæ in the first two stages of growth are oval, flat, and yellow, with 2 black eyes. At first they are very active, but after the second molt they become fixed to the bark and change into pupæ.

The species is found over nearly all of Japan, where it attacks chiefly the mulberry, but also some other trees, the branches frequently being completely covered with scales and the trees greatly injured. A crude method of treatment is to scrape off the scales from the bark, but spraying with limewater, kerosene emulsion, or a mixture of water, fish oil, and bicarbonate of soda, is recommended. A Chalcid and a Coccinellid prey upon the scale.

Some insects injurious to shade trees, J. B. SMITH (*New Jersey Stas. Bul. 103, pp. 15, figs. 4*).—Descriptive life history and remedial notes on the elm-leaf beetle (*Galeruca xanthomelæna*), wood leopard moth or imported elm borer (*Zeuzera pyrina*), and the white-marked tussock moth (*Orgyia leucostigma*). Spraying with London purple, Paris green or arsenate of lead is recommended for the elm-leaf beetle, an application to be made when the beetles are first noticed, a second when the larvæ begin to hatch, and a third 10 days later. The only remedy

available against the wood leopard moth appears to be cutting down and burning all infested trees and branches, or pouring a few drops of bisulphid in the burrows and closing the opening with putty. It is recommended that the egg masses of the tussock moth be removed from the trees during the winter and burned, and that the caterpillars be sprayed in June with some one of the arsenites.

General remarks on protecting shade trees from insect attacks are given, and a list of 21 shade trees, in the order of least susceptibility to insect injuries.

Insect Life (*U. S. Dept. Agr., Division of Entomology, Insect Life, vol. VII, No. 2, pp. 55–215, fig. 1*).—This number is devoted to the proceedings and papers of the sixth annual meeting of the Association of Economic Entomologists, which met at Brooklyn, New York, August 14 and 15, 1894.

Brief account of the rise and present condition of economic entomology, L. O. Howard (pp. 55–107).—This paper consists of a historical sketch of economic entomology from the Middle Ages to the present time, giving in detail the growth and extent of this science in the United States, Canada, Great Britain, Germany, Austria-Hungary, Italy, France, Spain, the Netherlands, Norway, Sweden, Russia, Finland, South America, India, South Africa, Australia, the West Indies, New Zealand, and Hawaii. The scope and value of the work in the different countries is treated at length and the various investigators mentioned. The entomological work of the experiment stations is reviewed and a bibliographical list of their publications given.

Bisulphid of carbon as an insecticide, J. B. Smith (pp. 108–110).—An account of experiments with this chemical against melon lice, a dram of the liquid being placed in a saucer or small tumbler by each hill and the whole covered with a large wooden bowl. This was left undisturbed for an hour, when upon examination all the aphides were found to be killed. In the ensuing discussion the method was spoken of by several members favorably and modifications suggested.

Report of committee on coöperation among station entomologists, J. B. Smith (pp. 112–114).—Recommendations of lines of work in which entomologists may assist one another, notably in the study of life histories and geographical distribution, and the testing of insecticides.

Spraying without a pump, J. M. Aldrich (pp. 114, 115).—A preliminary note on an apparatus for mixing kerosene with water at the instant of passing through the nozzle, thereby doing away with the necessity of making kerosene emulsion.

Notes on insecticides, C. L. Marlatt (pp. 115–126).—General remarks on the scientific use of insecticides and notes on experiments with applications of standard insecticides, new insecticides, and modifications of old ones. The new peach scale (*Diaspis linatus*) and the euonymus scale (*Chionaspis euonymi*) were the species against which most of the experiments were directed, and kerosene emulsion proved

most beneficial. Arsenate of lead was satisfactorily tested against the elm-leaf beetle, and Bordeaux mixture was combined with kerosene emulsion with good results.

Some observations on new and old insecticides and their combination with fungicides, B. T. Galloway (pp. 126–131).—General accounts of experiments in this line, notably with Bordeaux mixture combined with various insecticides, such as kerosene emulsion, Paris green, and resin wash, with formulas for the preparation of the various mixtures.

Spraying with arsenites vs. bees, F. M. Webster (pp. 132–134).—In order to determine definitely the injurious effect on bees, produced by spraying fruit trees when in bloom, two blossoming apple trees were sprayed with Paris green and bees caught visiting the flowers were analyzed. Traces of arsenic were found in the abdomens and honey sacs, though the exteriors of the bodies gave none of the poison. Bees and larvæ showing traces of arsenic were also found dead in and about adjacent hives, and in consequence it is urged that fruit trees be not sprayed before the falling of the bloom.

Economic entomological work in the parks of New York City, E. B. Southwick (pp. 135–138).—General remarks on the treatment of injurious insects in the New York City parks, with notes on several species, especially *Orgyia leucostigma*, *Zeuzera pyrina*, sap fly, and the elm-leaf beetle. Streams of water were sprayed upon plant lice by means of hose, with good results.

The wood-leopard moth in the parks of New York City, E. B. Southwick (pp. 138–140).—Notes on the life history of *Zeuzera pyrina* and the injuries caused to trees by it.

Work in economic entomology at the University of Kansas for the season of 1894, F. H. Snow (pp. 140–144).—Notes on satisfactory treatment of the chinch bug with *Sporotrichum globuliferum*, and upon *Agrotis introferens*, which cutworm was destructive to alfalfa and wheat.

Notes on some discoveries and observations of the year in West Virginia, A. D. Hopkins (pp. 145–151).—Life histories and notes on various injurious insects, especially the Columbian bark beetle (*Corthylus columbianus*), the potato-scab gnat (*Epidapus scabies*), and the chestnut timber worm (*Lymexylon sericeum*).

The eastern occurrence of the San José scale, L. O. Howard (pp. 153–163).—A review of the recent attacks of the San José scale in the eastern United States, with mention of the infested localities and a detailed account of the remedial treatment. The pest was spread from New Jersey nurseries that had distributed infested trees procured from California. A scymnid beetle (*Pentilia misella*) has been found to feed upon the scale.

The San José scale in New Jersey, J. B. Smith (pp. 163–167).—Notes on the occurrence of the pest in the State, with the treatment applied. Pears were chiefly attacked.

Mealy bugs and their allies, G. C. Davis (pp. 168–175).—Descriptive and life-history notes on *Dactylopius destructor*, *D. longifilis*, *D. trifolii*, and *Aleyrodes vaporarium*, with accounts of experiments.

The pear-tree psylla in Maryland, C. L Marlatt (pp. 175–185).—Notes on a sudden and overwhelming invasion of *Psylla pyricola* in two large pear orchards of southern Maryland, where the pest was introduced from a New York nursery. Twenty thousand trees were affected, and experiments were made with different emulsions against the pest. Kerosene emulsion applied when the eggs are hatching in the spring and winter spraying with a strong solution of the same are recommended. The lace-wing fly (*Chrysopa oculata*) and a ladybird, *Adalia bipunctata*, were effective destroyers of the psylla.

Notes of the year in New Jersey, J. B. Smith (pp. 185–197).—More or less detailed notes on injurious insects, especially the San José scale, pear psylla, pear midge, pear borer (*Agrilus acutipennis*), seventeen-year locust, and melon louse.

Special economic insects of the season, G. C. Davis (pp. 198–201).—Notes on *Diplotaxis harperi* attacking strawberries, a raspberry maggot (*Adimonia cavicollis*) on cherry foliage, *Notoxus anchora* eating cherries, and *Mononychus vulpeculus* destroying iris flowers.

Additional notes on the strawberry weevil, its habits and remedies, F. H. Chittenden (p. 201).—This paper was published in Insect Life, vol. VII, No. 1, pp. 14–23 (E. S. R., 6, p. 562).

Notes on the insects of north Idaho, J. M. Aldrich (pp. 201, 202).—General notes on several common fruit pests imported from the East.

Insects of the year, F. M. Webster (pp. 202–207).—Notes on various insect attacks, particularly those of the clover-leaf weevil, and a thrips, probably *Limothrips tritici*, which caused serious injury to onions.

Notes from New Mexico, T. D. A. Cockerell (pp. 207–211).—General remarks on insects in the Mesilla Valley and about Santa Fe.

Some experiences with mosquitoes, H. E. Weed (pp. 212, 213).—Notes on destroying mosquito larvæ by placing kerosene on the surface of the water where they bred.

A list of the American and foreign members of the association is appended.

Bordeaux mixture as a deterrent against flea beetles, L. R. JONES (*Agl. Sci., 8 (1894), No. 6–9, pp. 364–367, pls. 2*).—In consequence of the attacks of the cucumber flea beetle on potato plants in Vermont being scarcely at all checked by applications of Paris green, experiments were made with different strengths of Bordeaux mixture, ammoniacal copper carbonate, and modified eau celeste to ascertain their value as insecticides. The results were most satisfactory and far superior to those obtained by dusting the infested plants with a mixture of Paris green and land plaster. It is recommended that 2 applications of a strong solution of Bordeaux mixture be made, the first early in June,

and another in July, which will in most cases be sufficient. Soap mixed with the solution was found to add slightly to its insecticidal value.

Farm practice and fertilizers as insecticides, J. B. SMITH (*Ontario Ent. Soc. Rpt. 1893, pp. 68–70*).—This paper treats of combating injurious insects by means of cultural methods, chief among which are suggested manuring with chemical fertilizers. Nitrate of soda and kainit are considered especially valuable, and the peach aphis, corn webworm, cabbage maggot, and wireworm are stated as insects against which these chemicals have been used effectively. Intelligent rotation of crops is also suggested.

Experiments with Botrytis tenella for destroying white grubs (*Deut. landw. Presse, 21 (1894), No. 88, pp. 828, 829*).—Four cages were made and the bottoms filled with earth, in which lettuce was planted, and after the plants were growing vigorously 25 white grubs were introduced into each cage. The grubs were buried at different depths in the earth, and 2 of the cages were kept very moist, while the other 2 were allowed to become quite dry. Two grubs were then infected with *Botrytis*, by being shaken up in a test tube with water and spores of the fungus, and placed one in a moist and the other in a dry cage. Two months afterwards the cages were examined, and though the experiment was interfered with by a severe mortality of the grubs, occurring in the check cages as well as in those infected, yet, since only 2 grubs remained alive in the infected damp cage as against several in the others, the destructive power of *Botrytis* under moist conditions is believed in. The fungus did not seem to act in the dry cage infected.

The spermatogenesis of the silkworm, K. TOYAMA (*College of Agr., Tokyo, Japan, Bul., vol. 2, No. 3, pp. 125–157, pls. 2*).—Technical embryological, anatomical, and physiological notes of investigations of this subject, with extensive figures.

The dragon fly, T. J. MACLAUGHLIN (*Ontario Ent. Soc. Rpt. 1893, pp. 55–60, figs. 6*).—Semipopular descriptive and systematic notes on some of the common dragon flies, their habits and effectiveness in destroying mosquito larvæ being particularly dwelt upon.

Mosquitoes, J. A. MOFFAT (*Ontario Ent. Soc. Rpt. 1893, pp. 43–48*).—General and popular notes on the geographical distribution and life history of *Culex pipiens*, with a discussion of the anatomy of the mouth parts and the physiological action of the bite. Burning pyrethrum powder in the house is recommended, as also growing castor beans and treating stagnant pools with kerosene.

Effects produced by ticks upon their hosts (*Agl. Jour. Leeward Islands, 1894, Oct., pp. 36–44*).

The cheese or meat skipper, M. E. MURTFELDT (*Ontario Ent. Soc. Rpt. 1893, pp. 98–101*).—Notes on the history, ravages, and life history of *Piophila casei*, the use of screens being advised as a preventive.

A new scale insect found on plum, T. D. A. COCKERELL (*Canadian Ent., 27 (1895), No. 1, pp. 16–19*).—*Aspidiotus howardi* is described as a new species from Colorado.

The bud moth, M. V. SLINGERLAND (*New York Cornell Sta. Rpt. 1893, pp. 27–52, figs. 8*).—A reprint of Bulletin 50 of the station (E. S. R., 4, p. 930).

The four-lined leaf bug, M. V. SLINGERLAND (*New York Cornell Sta. Rpt. 1893, pp. 217-248, figs. 13*).—A reprint of Bulletin 58 of the station (E. S. R., 5, p. 406).

Grasshoppers, J. FLETCHER (*Ontario Fruit Growers' Assn. Rpt. 1893, pp. 29-32*).—General and popular notes on the invasions of these insects, life history and treatment being given. A mixture of bran, arsenic, and sugar is recommended.

Destructive Scolytids and their imported enemy, A. D. HOPKINS (*Ontario Ent. Soc. Rpt. 1893, pp. 71-75*).—General remarks on the habits of various Scolytid bark beetles, especially *Dendroctonus frontalis* and *D. terebrans*, with notes on the introduction of *Clerus formicarius* from Germany to combat them. About 3,000 specimens of the latter beetle have been imported and placed in different sections of the pine forests in West Virginia, with already beneficial results.

Keys to the genera of Pediculidæ and Mallophagidæ, H. OSBORN (*Amer. Monthly Micr. Jour., 15 (1894), n. ser., No. 11, pp. 344-346*).—Technical analytical synopses of these lice.

Preliminary studies in the Siphonoptera, C. F. BAKER (*Canadian Ent., 27 (1895), No. 1, pp. 19-22*).—The first part of a technical paper.

Insect foes of American cereal grains, with measures for their prevention or destruction, F. M. WEBSTER (*Ontario Ent. Soc. Rpt. 1893, pp. 88-93*).—Notes on some of the more important insects attacking corn, wheat, and oats, the Hessian fly, chinch bug, Isosomas, apple-leaf louse, wireworms, white grubs, and cutworms being especially treated of.

Parasitic and predaceous insects in applied entomology, C. V. RILEY (*Ontario Ent. Soc. Rpt. 1893, pp. 76-84*).—General discussion of the value to man of the parasitic and predaceous insect enemies of such species as injure vegetation, with special remarks on some of the more important injurious insects and their enemies. Insects preying upon scale insects are especially mentioned and the Capri fig insect (*Blastophaga psenes*) is stated as almost invaluable in the fertilization of fig blossoms.

Injurious insects, W. H. HARRINGTON (*Ontario Ent. Soc. Rpt. 1893, pp. 17-31*).—Descriptive, life history, and remedial notes on the larch sawfly, rose sawflies, pear-tree slug, Cornel sawfly, fall cankerworm, and a few other insects of less injuriousness. Parasitism in insects is briefly treated of, and a careful study of entomological publications urged.

Injurious insects of the year, J. FLETCHER (*Ontario Ent. Soc. Rpt. 1893, pp. 8-13, figs. 8*).—This paper treats of some of the most important insect attacks of the season, particularly a maple gall moth, a squash carrion beetle, cutworms, turnip flea, horn fly, and locusts.

Insects injurious to plants, L. WOOLVERTON (*Ontario Fruit Growers' Assn. Rpt. 1893, pp. 101-106*).—A more or less popular paper on the life history and treatment of the codling moth, curculio, oyster-shell bark louse, pear-tree psylla, raspberry gallfly, and the parasites of the latter.

Nurseries as factors in the distribution of insect pests, J. B. SMITH (*Agl. Sci., 8 (1894), No. 6-9, pp. 361-363*).—A short discussion of the subject, citing the San José scale as an example of an injurious insect spread by nursery stock, and urging that the utmost care be exercised both by nurserymen and by orchardists to avoid the introduction of insects and plant diseases that have proved injurious elsewhere.

Report of entomologist, P. H. ROLFS (*Florida Sta. Bul. 24, p. 19*).—Brief mention of the entomological work during the year, specimen cases and rearing cages being added to the station outfit.

Arsenical spraying of fruit trees while in blossom, J. A. LINTNER (*Ontario Ent. Soc. Rpt. 1893, pp. 102-104*).—A discussion of the experiments in regard to the poisoning of bees from the spraying of fruit trees with arsenites, and urging more careful and extended investigations. The effect of the poisoning on the blossoms, fruit development, and leaves is remarked upon, and some of the insects checked by spraying are mentioned.

Methods of attacking parasites of domestic animals, H. OSBORN (*Ontario Ent. Soc. Rpt. 1893, pp. 96, 97*).—General notes on the subject, especially mentioning the

treatment of bots by washes and dipping, and of lice by fumigation with sulphur or tobacco.

Fumigation with bisulphid of carbon for the complete and rapid destruction of insects which attack herbarium specimens, furs, woolens, etc., H. DU BUYSSON (*Ontario Ent. Soc. Rpt. 1893, pp. 94, 95*).—Detailed directions for the use of this insecticide for the purposes mentioned.

Protection of asparagus from insect enemies, E. OSCHENDORFF (*Deut. landw. Presse, 21 (1894), No. 78, p. 793*).—Notes on preventive treatment of several insects, especially the asparagus beetle.

Remedies against the grass cutworm (*Ztschr. landw. Ver. Hessen, 1894, No. 23, pp. 185, 186*).—General notes on ravages by the caterpillars of *Charæas graminis.* Kerosene emulsion seems to be preferred as an insecticide.

The rose chafer or rose bug, how to deal with it, F. M. WEBSTER (*Ohio Hort. Soc. Rpt. 1893–'94, pp. 87–91*).—Life-history notes on *Macrodactylus subspinosus*, and the results of experiments in combating it. Plowing the sandy soil in which the insect breeds 3 in. deep in May and early June is recommended, and hand picking the adults.

A remedy for insects injuring sugar cane, F. A. F. C. WENT (*Sugar Cane, 26 (1894), No. 303, pp. 551, 552*).—Notes on experiments.

Circumstances favoring the extension of fungus diseases among insects, P. VUILLEMIN (*Rev. Mycol., 17 (1895), No. 1, pp. 21, 23*).

Defense of insects against parasites, L. CUÉNOT (*Compt. Rend., 19 (1894), No. 19, pp. 806–808*).—Brief notes on some of the means by which insects escape parasitism, crickets being especially mentioned.

The economic value of parasites and predaceous insects, J. B. SMITH (*Ontario Ent. Soc. Rpt. 1893, pp. 84–87*).—General discussion of the subject, with particular reference to the insect enemies of scale insects, potato beetles, cranberry insects, codling moth, and melon louse.

Investigations of bacteria infesting caterpillars, K. ECKSTEIN (*Ztschr. Forst.- und Jagdw., 26 (1894), No. 1, p. 3; No. 4, p. 228; No. 5, p. 285*).—Notes on some experiments with insect bacterial diseases, with varying success.

FOODS—ANIMAL PRODUCTION.

Mannane as an article of human food, C. TSUJI (*College Agr., Tokyo, Japan, Bul., vol. 2, No. 2, pp. 103–105*).—There are sold in Japan as food gelatinous colorless tablets made from the tuberous rootstocks of *Amorphophallus rivieri durien*, a plant belonging to the *Aroideæ* and largely cultivated in Japan. These tablets appear to consist of starch paste, but do not give any reaction with iodin, and the author's investigations indicate that they are composed of mannane, a polyanhydrid of mannose. The dried ground rootstock yielded 55.86 per cent of mannose. All attempts to convert the mannose of this powder into a sugar by diastase were unsuccessful.

Rations fed to milch cows in Connecticut, C. D. WOODS and C. S. PHELPS (*Connecticut Storrs Sta. Bul. 13, pp. 16*).—In the Annual Report of the station for 1893 (E. S. R., 6, p. 458) the details were given of the study of the rations fed to 16 herds of cows in Connecticut. In the winter of 1893–'94 this study was continued on 6 herds. A representative of the station visited these farms and remained during the test, which in 4 cases lasted 12 days, weighing and testing the milk,

weighing the foods and sampling them for analysis, and collecting statistics as to the breed, age, period of lactation, etc., of the cows. As soon as the analyses of the feeding stuffs could be made the rations were calculated and in 3 cases other rations were suggested. The feed was gradually changed to the suggested ration, and after 4 weeks from the close of the first test another 12 days' test was made. The summary of the results of these 2 tests at the 3 farms is given in the following tables, test No. 1 indicating the original ration and No. 2 the suggested ration in each case:

Summary of daily rations fed and daily milk and butter yield from three herds with a wide and a narrower ration.

Herd.	Average weight of cows.	No. of test.	Daily ration per head.					Average daily—		Total cost of food to produce—	
			Digestible protein.	Fuel value of digestible nutrients.	Nutritive ratio.	Total cost.	Net cost.	Milk flow.	Yield of butter.[1]	100 lbs. milk.	1 lb. butter.
	Lbs.		*Lbs.*	*Calories*	*1:*	*Cts.*	*Cts.*	*Lbs.*	*Lbs.*		*Cts.*
A	825	1	2.15	32,750	7.3	26.6	14.3	18.1	1.07	$1.47	25
		2	2.39	29,400	5.7	21.7	9.8	18.9	1.00	1.15	19
B	750	1	1.49	25,800	8.5	18.6	9.5	18.1	.87	1.00	21
		2	2.01	24,700	5.7	18.3	9.0	17.9	.89	1.03	20
C	725	1	1.38	21,150	7.3	19.4	12.5	13.7	.65	1.41	30
		2	1.80	22,400	5.7	17.8	9.9	13.6	.69	1.30	26
Suggested rations	825	....	2.06	25,600	5.6	......	......	......	......	....	....
	750	....	1.88	23,250							
	725	....	1.81	22,500							

[1] Butter assumed to contain 85 per cent butter fat.

"At the time of the second test in each case the cows were 6 weeks further along in the period of lactation, and would in consequence have naturally reduced their milk flow and butter yield. . . .

"In the case of herd A, instead of a falling off in milk flow there was an average daily increase of seven tenths of a pound in the test while they were fed the narrow ration over what it had been with the wide ration 6 weeks earlier. There was practically no change in milk flow in the case of the two other herds. With all three herds there was a slight increase in butter yield with the narrow ration in the second test. The total size of the ration as measured by the fuel value averaged less in the second test than in the first. The protein was increased and the carbohydrates and fats were decreased in the second test.

"In these cases both milk flow and butter yield were so much affected by a change from a wide to a narrow ration that instead of a shrinkage in production, as would naturally follow from advancement in period of lactation, the animals more than held their own. . . .

"The cost of milk and butter production from the food alone was much less on the narrower ration, even when the cows were 6 weeks further advanced in lactation than earlier on the wide ration. So far as these tests may be taken as an indication, narrow rations may be fed more profitably than wide."

The rations of the 16 herds studied previously are arranged according to nutritive ratio and amount of protein in the ration. A comparison of these data with the yields of milk and butter develops the following facts:

"The animals having the narrower rations produced on the average one tenth of a pound more of butter per day than those having the wider, and those having the larger amounts of protein gave, on the average, two tenths of a pound more of butter per day than those having the smaller quantities of protein. Too much importance should not be attached to these results, as they may have been partly accidental, and due to causes other than feed. It is, nevertheless, a noteworthy fact that in the cases in which the cows were in about the same period of lactation, the yields of butter decreased as the protein decreased, and as the nutritive ratio increased. This would seem to indicate that it would be safe in general to feed as much or even more protein than called for by Wolff's standard ration if we would obtain the largest yields of butter from our milch cows."

Feeding experiments with fat-extracted fish meal for cows, KÜHN-CORNIETEN (*Molk. Ztg.*, *81* (*1894*), *No. 44*, *p. 675*).—A practical trial with 6 cows. Ground fish, freed from fat, was gradually introduced into the ration as a substitute for brewers' grains and sunflower-seed cake. From 1⅓ to 2⅓ lbs. (German) per head was fed, and several analyses of the milk were made at the Königsberg station. The yield and composition were fairly well maintained on the fish meal. In regard to the quality of the milk and butter, Professor Klein, of the Königsberg station, reported that they did not differ especially from that produced on oil cakes. After keeping for a half year the butter, although it was somewhat rancid and tasted old, had no fishy or unusual taste. The fish meal had no ill effects upon the cows.

Comparative value of mixed grain and wheat bran or shorts for milch cows, F. FRIIS (*Kgl. Vet. Landt. Lab. Landökon. Forsög.*, *Copenhagen*, *Bul. 29*, *1894*, *pp. 76*).

Synopsis.—Feeding experiments conducted during 1893 and 1894 by the State experiment station at Copenhagen, Denmark, at 7 different estates with 447 cows in all. Mixed oats and barley were compared with wheat bran and with wheat shorts. No appreciable difference was found as to the effect of the feeds given on either yield or composition of the milk produced. The tendency was toward a slight superiority of the bran over the grain, and of shorts over the bran.

The report describes the sixth and seventh series of feeding experiments with milch cows conducted by the Danish State agricultural experiment station. The plan of the experiment was similar to that of the preceding series (E. S. R., 4, p. 601). The experiments were conducted during 1893 and 1894 at 7 different estates with 247 and 240 cows, respectively. All the cows received the same feed during the preliminary period and the after feeding (the post-experimental period). During the experiment proper the feed of one lot of cows remained as in the preliminary period, while that of the other two lots was changed in the manner indicated by the following example: At one of the estates (Bregentoed) all cows received during the preliminary feeding and during period 2 3 lbs.[1] of mixed grain (one third barley, two thirds oats), 3 lbs. of wheat bran, 2 lbs. of oil cakes (equal parts of rape, palm

[1] Danish pounds; 1 lb. Danish=1.1 lb. avoirdupois.

nut, and sunflower-seed cake), 20 lbs. of mangel-wurzels, 6 lbs. hay, and straw *ad libitum.* During period 1 the grain feed was changed for lot A to 6 lbs. mixed grain, and for lot C to 6 lbs. of wheat bran, in both cases in the place of 3 lbs. each of grain and bran.

At some estates there was a fourth lot (D) which received wheat shorts in the place of wheat bran, but otherwise the same as lot C. Analyses of products and of fodders fed were made as in previous experiments.

Effect on quality of milk.—The average percentages of fat for all cows included in the experiments of both years were as follows:

Average per cent of fat in milk.

Lot.	Experiments of 1893.			Experiments of 1894.			Average for both years.		
	Preliminary period.	Period 1.	Period 2.	Preliminary period.	Period 1.	Period 2.	Preliminary period.	Period 1.	Period 2.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
A	3.13	3.09	3.27	3.04	2.99	3.25	3.09	3.04	3.26
B	3.13	3.16	3.30	3.06	3.06	3.28	3.10	3.11	3.29
C	3.12	3.14	3.28	3.09	3.10	3.30	3.10	3.12	3.29

There is no marked difference in the fat content of the milk produced by the different lots during either period of the experiment. There was a small decrease in the fat content of the milk produced by lot A during period 1, in 11 out of 14 series, over that of lot B. From period 1 to period 2 there was a similar increase in the per cent of fat in the milk produced by this lot. These differences are, however, in the author's opinion, too small to be of any practical importance.

The complete chemical analyses of the samples of milk from the different lots also failed to disclose any decided difference in the composition of the milk attributable to the different concentrated foods fed, and the author therefore concludes that "in the comparative feeding trials with milch cows now continued for 7 consecutive years at this station, in which 1,639 cows have been included (separated into 161 lots on 10 estates in different parts of our country), it has been found over and over again that the changes made in the food of the lots have had practically no influence on the chemical composition of the milk. In these experiments grain has been fed against roots, against oil cake, and against wheat bran or shorts; grain and oil cakes have been fed against roots, or roots have been fed as an additional food."

Effect on milk yield of cows.—At the beginning of the experiments the cows in lots A, B, and C had been in milk 93, 93, and 94 days, respectively, as an average for both years. The average age of the cows in lots A, B, and C was 7.7, 7.6, and 7.6 years, respectively. These two factors are of the greatest importance in determining the decrease in milk yield of a number of cows during a given period. The average

daily yields of milk for each lot during the different periods were as shown below:

Average daily yield of milk per cow.

Lot.	Experiments of 1893.			Experiments of 1894.			Average for both years.		
	Preliminary period.	Period 1.	Period 2.	Preliminary period.	Period 1.	Period 2.	Preliminary period.	Period 1.	Period 2.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
A	24.7	21.3	19.0	25.8	22.4	20.6	25.3	21.9	19.8
B	24.6	21.6	19.5	25.8	22.5	21.2	25.2	22.1	20.3
C	24.7	21.8	19.7	25.8	22.3	20.9	25.3	22.1	20.3

The results indicate a similar nutritive effect in the feeds compared with a slight increase in favor of the wheat-bran feeding. The differences found, however, are not on the average greater than what might have been found in feeding a similar number of cows the same feeding stuffs for several months.

The average live weights of the cows increased during the experiment; the increase was greater for lot B than for lot A, and greater for lot C than for lot B. The cows in lot B and C ate somewhat more straw than those in lot A, the difference being about 0.4 lb. per head daily.

Wheat shorts vs. wheat bran.—The experiments with these foods were conducted with 240 cows, 6 trials being made in all on 3 different estates each year. No appreciable difference was apparent in the effect of the foods either on the quality or the quantity of milk produced, or in change of live weight of the cows during the experiment. A small difference in favor of shorts as regards the yield of milk was found in 3 trials.—F. W. WOLL.

Record of a herd of cows at Weende, BACKHAUS (*Jour. Landw. 42, No. 3, pp. 213–281*).—This is the individual record for one year of a herd of 59 cows. Trial milkings were made weekly, and composite samples were taken for testing.

Of the 20 cows which gave over 4,000 kg. of milk during the year, 14 had a relatively short lactation period, calving during the year, while only 6 gave milk throughout the year. The results indicate that as far as the milk yield is concerned it is most advantageous to have the cows calve as often as possible. In the majority of cases the milk yield and the fat content were in inverse proportion. Usually the fat content increased as the milk yield decreased with advancing lactation; and out of the 20 cows giving over 4,000 kg. of milk only 6 gave milk with the average fat content for the herd—3.266 per cent. The percentage of solids not-fat was usually much more uniform than that of fat. In the case of 3 cows which did not get with calf, there was no increase in the percentage of fat and solids-not fat as they shrunk in milk, and 3 other cows tested for a short time and then sold because they did not get with calf showed a similar tendency. This suggests

to the author the theory that the increase in the richness of milk with advancing lactation may follow as a result of being with calf rather than of the shrinkage in yield.

Fattening lambs, C. D. SMITH and F. B. MUMFORD (*Michigan Sta. Bul. 113, pp. 27*).—This experiment was made to compare different grain foods for lambs during winter. It included 125 grade Shropshire lambs, divided into 9 lots, which were fed in the barn from November 27 to March 12. The food was given to all *ad libitum.* It consisted of clover hay with different grain feeds, with or without roots. The rations, aside from the clover hay, are given in the following table, together with the amounts of protein and carbohydrates which the animals in each lot consumed per 1,000 lbs. live weight daily:

Character and composition of rations of lambs.

Lot.	Ration.	Nutrients fed daily per 1,000 lbs. live weight, Protein.	Nutrients fed daily per 1,000 lbs. live weight, Carbohydrates.	Nutritive ratio of food.
		Pounds.	*Pounds.*	
1	Whole corn	2.0	16.0	1:8.0
2	Whole corn and roots	2.1	16.7	1:8.0
3	4 parts corn to 1 part linseed meal. and roots	2.7	16.1	1:6.0
4	4 parts corn to 1 part linseed meal	2.8	15.7	1:5.6
5	Whole corn and wheat bran, equal parts	2.5	14.8	1:6.0
6	Whole corn and whole wheat[1]	2.1	15.5	1:7.5
7	5 parts whole wheat to 1 part linseed meal	2.7	15.0	1:5.5
8	Whole corn ("self-feed")	2.0	15.7	1:7.9
9	Whole corn and wheat bran, equal parts ("self-feed")	2.6	16.1	1:6.2

[1] Proportion not stated.

The linseed meal used was new process. The roots consisted of a mixture of equal parts of ruta-bagas and sugar beets. A detailed record is given for each lot of the food eaten, gains, cost of food eaten, and the financial result. In the latter the lambs are reckoned at 3 cts. per pound at the beginning and at 3.9 cts. per pound at the close of the experiment, and no allowance is made for the value of manure or the cost of attendance. The relations of temperature to gain, of carbohydrates and protein to gain, and of temperature to the amount of dry matter required to produce a pound of gain are discussed and illustrated graphically.

A summary of the results is as follows:

Lot.	Ration.	Average weekly gain.	Dry matter fed per pound of gain.	Cost of food per pound of gain.	Average profit per lamb.
		Pounds.	*Pounds.*	*Cents.*	*Cents.*
1	Corn	2.18	7.02	4.6	51.0
2	Corn and roots	2.64	6.41	4.6	45.6
3	Corn, linseed meal, and roots	2.61	6.72	5.3	20.0
4	Corn and linseed meal	2.38	6.99	5.1	31.0
5	Corn and bran	1.78	9.13	5.3	17.0
6	Wheat and corn	1.97	7.64	5.4	31.0
7	Wheat and linseed meal	1.94	8.04	6.3	1.0
8	Corn ("self-feed")	1.65	8.57	5.7	30.0
9	Corn and bran ("self-feed")	1.58	10.03	6.8	2.0

"(1) Under the conditions existing in this experiment the lot receiving a good quality of clover hay with a grain ration of whole corn required less dry matter to produce a pound of gain, made greater gains, were in better flesh, and in general were fed at a greater profit than the lots fed corn and bran, corn and wheat, or wheat and oil meal.

"(2) Lots receiving roots in the ration required less dry matter to each pound of gain, made greater gains, and drank less water than the other lots fed the same ration without the roots.

"(3) This experiment would seem to indicate that, when the conditions are similar to those in this test, the feeding of wheat to fattening lambs is better practice than selling at the prices prevailing during this experiment.

"(4) This experiment indicates that lambs may be successfully fattened by means of a self-feed, but the gains made are produced by a greater consumption of dry matter for a pound of gain, and are consequently less profitable than gains resulting from feeding at regular intervals in the ordinary manner.

"(5) In this experiment the value of foods for fattening purposes seems to depend more upon the supply of available carbohydrates than upon the supply of protein.

"(6) Cold temperatures were favorable to increased gains and warm temperatures were very generally accompanied by decreased gains.

"(7) Less dry matter was required to produce a pound of gain in cold than in warm temperatures."

Grain feeding lambs for market, J. A. CRAIG (*Wisconsin Sta. Bul. 41, pp. 21*).—Three separate experiments are described in feeding grain to lambs before weaning, between weaning and fattening, and during the fattening period only. In the first two experiments there were 2 lots of lambs, one lot being fed grain from before weaning until the close of the fattening period, and the other lot receiving no grain until the fattening period. In the third trial there were 3 lots, the grain feeding commencing with one lot before weaning, with another after weaning, and with the third during the fattening period.

The grain fed before weaning was corn meal, wheat bran, and linseed meal; between weaning and fattening, corn and linseed meal, or whole oats; and during fattening, corn, oats, and linseed meal, or corn and linseed meal, or corn and oats. Between weaning and fattening the lambs were all pastured.

The feeding period before weaning was 10 to 12 weeks; between weaning and fattening, 14 to 19 weeks, and the fattening period, 12 to 14 weeks. At the end of each period the lambs were valued by a local butcher. In estimating the relative cost, the gain only is considered and no account taken of the pasturage. The first experiment has been already reported in the Annual Report of the station for 1892 (E. S. R., 5, p. 503). The results of the 3 experiments are tabulated in the bulletin, and are concisely stated in the following summary:

"(1) The feeding of grain before weaning produced an average of 61 cts. per head more profit at weaning time than that obtained from the lambs receiving no grain. The average value of each lamb in the lot receiving grain at \$5.66 per 100 lbs. was \$3.83 per head, and the average value of the grain they ate was 33 cts. per head, while the average value of the other lot not receiving grain at \$4.91 per 100 lbs. was \$2.89, leaving 61 cts. profit per head in favor of grain feeding. The average of the three trials shows that the grain-fed lambs before weaning required 4 lbs. of grain for each 1 lb. of gain that they made over the lambs that had no grain.

"(2) The feeding of grain after weaning to lambs that had not received any before weaning produced an average increase which slightly more than paid a good market price for the grain they ate up to the time they were to be sold in the fall. The average value of each lamb in the fall after having received grain from weaning time was $3.66 at $4 per 100 lbs., and they ate 54 cts. worth of grain per head, while the average value per head of those that had not received grain, at $3.81 per 100 lbs., was $2.96, a difference of 16 cts. in favor of the lambs fed grain since weaning. As the average of the three trials it required 6.7 lbs. of grain for the grain-fed lambs to make 1 lb. of gain more than those that had no grain.

"(3) The feeding of grain both before and after weaning produced an average of 34 cts. per head more profit if sold in the fall than that obtained from the lambs that were not fed grain. The average value in the fall of each lamb in the lots receiving grain before and after weaning, at $4.81 per 100 lbs., was $4.82, and the average cost of grain was $1.38, while at the same time those that had no grain, at $3.81 per 100 lbs., were worth an average of $3.10 per head; a difference in profit of 34 cts. per head to the credit of the lambs that received grain.

"(4) The results of the three trials show that there is no appreciable difference in the gain made during the winter fattening between the lambs that had grain previous to fattening and those that had not. The difference in the cost of gain was more marked, there being an average difference of 29 cts. per 100 lbs. in favor of those that had no grain previous to fattening. The average weekly gain per head of the lambs fed grain previously was 2.89 lbs. during the fattening, while that of the other lambs was 2.95. The average cost of 100 lbs. of gain was $4.93 in the instance of the grain-fed lambs, and $4.66 with those that had no grain before fattening started.

"(5) When the experiment was concluded and the lambs that had grain before fattening and those that had not were ready for market, the average profit from the former was 48½ cts. per head greater than from the latter. The average weight of the grain-fed lambs when sold was 140.2 lbs., and that of the others was 121.7 lbs. per head. The former brought 75 cts. per 100 lbs. more than those that had no grain before winter feeding.

"(6) The grain feeding had a marked influence on the earliness of the maturity of the lambs. In the first two trials the grain-fed lambs reached an average of 125 lbs. per head in weight 7 and 4 weeks, respectively, before the others. In these trials the average cost of this weight in the instance of the grain-fed lambs was $2.68 per head, exclusive of pasture, while in the instance of the other lambs it was $1.96 per head. This difference in cost was largely due to the heavy feeding of grain after weaning, and when this was guarded against in the third trial it was found that the average of 113.9 lbs. per head, which the lambs that had no grain reached on the conclusion of the experiment, was made 7 weeks sooner by the lambs fed grain continuously, and it was made at a slightly less cost.

"(7) There was no difference in the character of the meat in the carcasses of the lambs that had grain continuously and those that had not.

"(8) The per cent that the lambs dressed was about the same in all lots, and no marked difference was found in the weight of the different organs of the body.

"(9) The feeding of grain made all the fleeces of the lambs receiving it more compact and smoother than the others.

"(10) The grain-fed lambs sheared in the 3 trials an average of 2.2 lbs. more wool than the others.

"(11) The greater amount of wool shorn by the grain-fed lambs was to an extent due to the greater amount of yolk or oil it contained. The shrinkage in the first two trials was 5 per cent greater in the instance of the grain-fed lambs than with the others, and in the last trial it was 2 per cent greater.

"(12) The wool on the lambs that were fed grain continuously grew to a slightly greater length than it did in the fleeces of the others. In the first trial the average

length of the shoulder fiber in the grain-fed lot was 5 in. as against 3.76 in the other; in the second trial, 4 in. as against 4.2 in.; and in the third it was 3.3 in. against 2.9 in. The second trial showed no appreciable difference in this particular."

Preliminary report of a feeding test with swine, E. R. LAKE (*Washington Sta. Bul. 11, pp. 31–36*).—A brief account of feeding 3 pigs for 55 days on wheat and barley chop alone or combined. The inference is drawn that barley chop alone is a more profitable feed than wheat alone at approximately the same price, and that barley and wheat mixed in the proportion of 1 to 2 is better than either alone.

Comparative investigations of rye spoiled by storing in elevators, and the bread baked from the same, THAL (*Pharm. Ztschr. Russland, 33, pp. 641–646; abs. in Chem. Centbl., 1894, II, No. 25, p. 1002*).

The use of salt as a cattle food, B. ROST (*Molk. Ztg., 8 (1894), No. 52, p. 803*).

Food stuffs for domestic animals in times of drought, N. BOCHICCHIO (*Staz. Sper. Agr. Ital., 27 (1894), No. 20, pp. 386–399*).

Analyses of fodder articles, C. A. GOESSMANN (*Massachusetts State Sta. Bul. 56, pp. 4–7*).—This includes tabulated analyses (food and in most cases fertilizing constituents) of 23 samples of feeding stuffs, including cotton-seed meal (decorticated and undecorticated), cotton-seed bran, gluten meals, and feeds of different kinds, oil cake, peanut cake, peanut husks, peanut feed, and meat meal.

Stock feeding in Illinois, G. E. MORROW (*Illinois Sta. Bul. 36, pp. 421–431*).—Replies to a circular letter were received from 108 feeders in different parts of the State in regard to feeding cattle, pigs, and sheep. These embody much practical information of interest and value, and are summarized in the bulletin. In addition the practical deductions from experiments on various phases of stock feeding, covering a number of years, are summarized.

Stock feeding, G. L. TELLER (*Arkansas Sta. Bul. 30, pp. 137–170*).—This is a popular bulletin on the subject of feeding, including information on the composition of feeding stuffs, the principles of feeding, feeding standards, calculation of rations, and tables showing the digestible nutrients in a number of feeding stuffs.

Tests of dairy cows at experiment stations, E. HITCHCOCK (*Cult. and Country Gent., 1894, Jan. 31, p.* 92).—A criticism of methods.

Cost of milk production, H. H. WING (*New York Cornell Sta. Rpt. 1893, pp. 69–95, pls. 2, figs. 4*).—A reprint from Bulletin 52 of the station (E. S. R., 4, p. 936).

Peanut oil as a food supplementary to skim milk in calf feeding, M. PETERSEN (*Fühling's landw. Ztg., 44 (1895), No. 1, pp. 13–17*).

VETERINARY SCIENCE AND PRACTICE.

Bovine tuberculosis, J. L. HILLS and F. A. RICH (*Vermont Sta. Bul. 42, pp. 70*).

Synopsis.—The subjects treated are the following: A detailed account of a tuberculin test of the station herd; the prevalence of tuberculosis in the State; a general discussion of the tubercle bacillus, of sources of infection, and of conditions favoring the development of tuberculosis; a brief description of the symptoms and lesions of the disease; a general discussion of the tuberculin test and of the objections sometimes urged against it; the interrelation of human and bovine tuberculosis; methods of sterilizing or pasteurizing milk; means of preventing the spread of tuberculosis, and the relation of the State toward this disease.

Thirty three animals in the station herd, most of them milch cows, were tested with tuberculin one or more times. In 24 instances there were reactions. *Post-mortem* examinations confirmed the test through-

out. The distribution of the disease was as follows: Lungs, bronchial and postpharyngeal glands, 90 per cent; udder and supermammary glands, 73 per cent; and intestinal and mesenteric glands, 50 per cent.

Of 786 Vermont cattle tested with tuberculin by the station veterinarian, 138 were tuberculous. Omitting the station herd and one other large herd in which five sixths of the animals were diseased, there were 39 tuberculous animals out of a total of 662. The proportion of tuberculous cattle in the State, however, is regarded as less than these figures would seem to indicate, for the herds in which the tests were made were those in which the presence of the disease was suspected.

In ascertaining the normal temperature of the animals tested, it was found convenient in some cases to determine this several days after the injection of the tuberculin was made.

The authors advise caution in the interpretation of tuberculin tests made on a 2-year-old with her first calf, as the first gestation renders the system highly susceptible to any excitement.

"It has been claimed that animals suffering from actinomycosis may react to tuberculin. From a practical standpoint, since lumpy jaw is contagious and communicated to man, this makes little difference, yet it is not impossible that there may have been tubercular lesions overlooked in these cases. One of us had 2 cases of this kind. One cow with lumpy jaw gave no reaction whatever to tuberculin; another, with both tuberculosis and lumpy jaw, gave the highest reaction (108.6°) yet obtained."

In over 1,000 cases injected there were found only 2 cases of nonreacting tuberculous cattle. Old cows responded less readily than other animals to the usual dose of tuberculin. In the author's experience no injurious effect has followed the use of tuberculin on healthy animals.

"It is already claimed that other materials will cause the same febrile reaction. Taurin and kreatin (Merck's) have given good results in the hands of Dr. W. L. Zuill, of Philadelphia, and E. Centanni claims that 'it has been proved that identically the same action as that of tuberculin can be produced by the injection of the extracts or other products of various bacteria, even such as are known to have no pathogenic (disease-producing) properties.' . . .

"The aggravation of the disease in tuberculous animals is not a valid argument in cases where such as react are promptly killed. No one who expects to keep his mild cases should permit its use, for it only makes a bad matter worse."

The bulletin contains data relative to the attitude toward tuberculosis of the boards having control of the live stock interests of Ontario, Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Maryland, Ohio, Indiana, Illinois, Tennessee, Michigan, Minnesota, Kansas, Colorado, Oregon, and Missouri.

Hog cholera and swine plague, D. E. SALMON (*U. S. Dept. Agr. Farmers' Bul. 24, pp. 15*).—This bulletin, prepared in the Bureau of Animal Industry, treats of the symptoms, *post-mortem* appearance, causes, treatment, and sanitary measures for the prevention of hog

cholera and swine plague. Experiments made during the past year indicate that the treatment of these diseases may be successful.

"The most efficacious formula which has been tried is the following:

	Pounds.
Wood charcoal	1
Sulphur	1
Sodium chlorid	2
Sodium bicarbonate	2
Sodium hyposulphite	2
Sodium sulphate	1
Antimony sulphid	1

"These ingredients should be completely pulverized and thoroughly mixed.

"The dose of this mixture is a large tablespoonful for each 200 lbs. weight of hogs to be treated, and it should be given only once a day. When hogs are affected with these diseases they should not be fed on corn alone, but they should have at least once a day soft feed, made by mixing bran and middlings, or middlings and corn meal, or ground oats and corn, or crushed wheat with hot water, and then stirring into this the proper quantity of the medicine. Hogs are fond of this mixture; it increases their appetite, and when they once taste of food with which it has been mixed they will eat it, though nothing else would tempt them.

"Animals that are very sick and that will not come to the feed should be drenched with the medicine shaken up with water. Great care should be exercised in drenching hogs or they will be suffocated. Do not turn the hog on its back to drench it, but pull the cheek away from the teeth so as to form a pouch, into which the medicine may be slowly poured. It will flow from the cheek into the mouth, and when the hog finds out what it is it will stop squealing and swallow."

An inquiry into the alleged relation existing between the Burrill disease of corn and the so-called cornstalk disease of cattle, V. A. MOORE (*Agl. Sci., 8 (1894), No. 6–9, pp. 368–385*).—The author's conclusions are as follows:

"(1) There is no species of bacteria or other microörganism which can be demonstrated by microscopic examination, or by ordinary bacteriological methods, constantly present in the organs or blood of cattle dying late in the fall or early winter of the so-called cornstalk disease.

"(2) The disease of corn described by Professor Burrill in the mature plant is widely distributed. Its lesions are usually associated with a single species of bacteria (*Bacillus cloacæ*).

"(3) Full-grown cornstalks affected with the corn blight have no ill effect upon cattle feeding exclusively upon them, neither do they produce a bacterial disease in rabbits.

"(4) The dwarfed cornstalks are harmless to rabbits. This form of the Burrill disease is presumably due to causes other than bacteria.

"(5) Pure cultures of the bacillus found in the lesions of the diseased corn, and supposed to be their cause, have no pathogenic effect on experimental animals, excepting when excessively large quantities are injected into the circulation.

"(6) The bacillus first described by Professor Burrill, and isolated by him from the lesions in the diseased corn, belongs to the *Bacillus cloacæ* group of bacteria, which is widely distributed in nature. This group of organisms is not known to be possessed of any marked economic importance.

"(7) There is no clinical or experimental evidence sufficient to show that the Burrill disease of corn is responsible for any disease in animals. There are, on the con-

trary, many facts to support the assumption that there is no causal relation whatever existing between this malady and the so called cornstalk disease of cattle."

The horse's teeth, E. P. NILES (*Virginia Sta. Bul. 36, pp. 7*).—This consists of a statement concerning the age at which the different temporary teeth are replaced and a general discussion of the symptoms attributable to defects of the teeth in colts and mature horses. None of the operations intended to remedy defects of the teeth are described.

Dehorning, I. P. ROBERTS (*New York Cornell Sta. Rpt. 1893, pp. 129-143, figs. 3*).—A reprint of Bulletin 54 of the station (E. S. R, 5, p. 204).

Losses following vaccination against anthrax, J. McFADYEAN (*Jour. Roy. Agr. Soc. England, 3d ser., 5 (1894), No. 20, pp. 800-807*).

Researches on the production of the charbon bacillus without spores, H. SURMONT and E. ARNOULD (*Ann. Inst. Pasteur, 8 (1894), No. 12, pp. 817-832*).

Investigations of bovine tuberculosis in New York State (*New York State Bd. Health, Fourteenth An. Rpt., vol. 2, p. 510*).—This consists of tabulated data giving in detail the statistics of herds examined and notes on *post-mortem* examinations of animals slaughtered.

The suppression of bovine tuberculosis and glanders, F. L. RUSSELL (*Maine Sta. Bul. 13, 2d ser., pp. 7*).—This bulletin consists of a general discussion of tuberculosis and glanders, and a statement of the diagnostic value of turberculin and mallein.

Contribution to the knowledge of the streptococci of yellow "galt," L. ADAMETZ (*Jour. Landw., 42, No. 3, pp. 231-241*).—A study of the microörganisms occuring in the milk of cows affected with a form of udder inflammation common in Switzerland under the name of *gelbe galt*.

DAIRYING.

Contribution to the study of the colostrum of the cow, V. HOUDET (*Ann. Inst. Pasteur, 8 (1894), No. 7, pp. 506-513*).—As first pointed out by Lassaigne[1] the formation of colostrum proper is preceded by the secretion of an albuminous liquid which sometimes begins to form 2 months before parturition. This secretion often appears under 2 forms—a brownish, viscous, honey-like product, and a lemon-yellow, non-viscous liquid, although the two are not always distinct and often coexist in the same animal, the earlier milkings furnishing the first, the later milkings the second. Examinations of samples of the viscous secretion showed it to be curdled by heating and precipitated by acetic acid, bichlorid of mercury, and alcohol, but not curdled by rennet. It was absolutely free from fat, and it contained traces of mineral matter, 63.14 per cent of water, 22.74 per cent of albuminoids soluble in water (to the extent of passing a Chamberland filter), and 14.12 per cent of albuminoids insoluble in water. The fluid secretion contained less water and less soluble albuminoids than the viscous secretion, and gave a barely appreciable precipitate with bichlorid of mercury and alcohol, but behaved in the same manner as the latter

[1] Ann. Phys. et Chim., 1837, 1841.

toward heat, acetic acid, and rennet. One hundred cubic centimeters of it contained the following amounts of dry matter:

Composition of fluid secretion preceding colostrum.

	In suspension.	In solution.
	Grams.	*Grams.*
Fat	0.15	
Lactose		0.80
Albuminoid matter	4.39	1.38
Phosphate of lime	0.03	0.08
Othersalts	0.14	0.24
Solids	7.21	

The composition of the fluid colostrum is thus seen to more nearly approach that of milk. Four or five days before parturition this secretion disappears entirely and is replaced by colostrum proper.

True colostrum is described as an opaque, yellow liquid of pungent taste. Sometimes it is of brick-dust or reddish color, due to the presence of blood. Its reaction is not well defined, being sometimes acid, sometimes alkaline, and sometimes amphotere. Churning colostrum for 1½ hours gave no butter, but in a centrifugal separator a yellow butter-like product was obtained. It is curdled by heat, acetic acid, bichlorid of mercury, and rennet. The more nearly its composition approached that of normal milk the less easily it curdled on heating and the less marked its color became. The following table shows the composition (100 cc.) of the colostrum of a Norman cow 6 days before calving (true colostrum just beginning to form), 4 days before calving, and immediately after calving:

Composition of colostrum at different stages.

	Six days before calving.		Four days before calving.		Just after calving.	
	In suspension.	Soluble.	In suspension.	Soluble.	In suspension.	Soluble.
	Grams.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Fat	0.50		3.01		3.14	
Lactose		2.35		3.17		2.70
Albuminoids	17.43	0.47	12.08	0.45	14.53	0.25
Phosphate of lime	0.33	0.11	0.37	0.10	0.35	0.11
Mineral salts	0.28	0.08	0.25	0.15	0.28	0.14
Solids	21.45		19.58		21.50	

These figures show a sudden increase in the amount of albuminoids over that contained in the fluid colostrum already reported (6.77 gm.). This may be due to a diversion to the udder of the nutritive material which up to this time had been supplied to the fetus and its connections. An increase in fat and phosphates and a decrease of soluble albuminoids will also be observed.

The following analyses of colostrum from a Norman cow which calved November 12 illustrate different stages of the transition of colostrum into normal milk:

Composition of colostrum at different dates.

	Fat.	Lactose.	Albuminoids.	Phosphate of lime.	Mineral salts.	Total solids.
	Grams.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
November 12:						
Suspended	5.69		14.05	0.39	0.44	24.60
Soluble		3.30	0.51	0.12	0.10	
November 13:						
Suspended	4.48		5.21	0.33	0.31	15.53
Soluble		4.05	0.93	0.10	0.12	
November 14:						
Suspended	5.70		3.52	0.23		16.40
Soluble		4.32	1.98	0.20	0.45	
November 15:						
Suspended	7.40		3.45	0.22		18.35
Soluble		4.26	2.41	0.21	0.40	
November 16:						
Suspended	3.20		5.20	0.26		14.10
Soluble		4.44	0.56	0.14	0.30	
November 18:						
Suspended	4.20		4.02	0.18		14.72
Soluble		4.64	1.19	0.20	0.29	
November 20:						
Suspended	4.10		3.56	0.27		13.80
Soluble		4.96	0.48	0.13	0.30	
November 28:						
Suspended	3.85		3.74	0.20		13.91
Soluble		5.03	0.58	0.15	0.36	

Analyses of colostrum from cows of other breeds are reported, confirming in general the above results.

The author concludes that after parturition the dry matter of colostrum decreases, then about the third day increases, and afterwards drops to the normal figure for milk. The quantity of fat is subject to great oscillations. The increase in milk sugar is gradual. The albuminoid matter exists both in suspension and in solution; both forms decrease after birth, the suspended albuminoids much more than the dissolved albuminoids. The phosphate of lime and other salts are abundant at first; 5 days after parturition their quantity is normal. By this time, in fact, the colostrum has gradually become normal in color and in its chemical composition and behavior toward rennet very similar to normal milk.

In conclusion, it is suggested that the changes in colostrum are the result of efforts of nature to adapt the food supply to the varying requirements of the young in the early stages of its life, the colostrum acting first probably as a purgative to remove from the intestines of the young animal the meconium which has accumulated during gestation.

On the composition of the milk of various animals, A. PIZZI (*Staz. Sper. Agr. Ital., 26 (1894), No. 6, pp. 615–639*).—Studies are reported on human milk and the milk of the goat, sheep, buffalo, mare, ass, rabbit, sow, dog, cat, and rat. All of the animals used had given birth to their young 12 to 40 days before the sample of milk was drawn. Butter was made from human milk and from the milk of the goat,

sheep, buffalo, and sow. The melting point, point of solidification, and volatile fatty acids (Wollny's numbers) of the butters were as follows:

Examination of butter from different kinds of milk.

Butter made from—	Melting point.	Point of solidification.	Volatile fatty acids (Wollny).
	Deg. C.	*Deg. C.*	
Human milk	32.0	22	1.42
Goat's milk	36.5	31	28.60
Sheep's milk	29–30.0	12	32.89
Buffalo's milk	38.0	29	26.18
Sow's milk	28.0	12	1.65

Owing to insufficient supply of milk, butter was not made from the milk of the other animals, but the fat was extracted from the milk by ether and the volatile acids determined in this. Mare's milk was distinctly alkaline, and Wollny's number for the fat was 11.22. Ass's milk gave a distinct reaction with red litmus paper, and Wollny's number was 13.09. Wollny's number for the fat of the milk of the rabbit was 16.06, the dog 1.21, the cat 4.40, and the rat 2.97. Sow's milk was quite alkaline, as was also that of the cat. The following table gives the composition of the milk of the buffalo and the rabbit:

Composition of buffalo's and rabbit's milk.

	Milk of buffalo.	Milk of rabbit.
	Per cent.	*Per cent.*
Water	82.2000	69.5000
Fat	7.9500	10.4500
Albuminoids	4.1300	15.5400
Sugar	4.7500	1.9500
Ash	0.9700	2.5600
Specific gravity at 15° C	1.0332	1.0493

A microscopical examination was made of the milk of the 12 kinds of animals named above, and it was found that the fat globules were largest in the milk of the rabbit and the mouse. The globules were smallest in the milk of the sow, ass, and mare. The milk of 4 cows was examined just before parturition and at different stages after calving. Three to 6 hours before parturition Wollny's numbers for the colostrum fat were 4.40 to 4.73, 6 hours after calving 6.16 to 6.27. After this time the volatile fatty acids rapidly increased, reaching in one instance 28.16 at 114 hours after calving, in another case 28.93 in 108 hours, in another reaching 29.81 at 60 hours, and in another being only 24.75 after 189 hours.

On tubercle bacilli in milk, K. ARNELL (*Kgl. Landt. Akad. Handl. Tidskr., 33 (1894), pp. 239–243*).—The author gives an account of the methods proposed by Ilkewitsch, Thörner, and Asessi, for the examination of milk for tubercle bacilli, and recommends the following method as reliable: The milk is treated according to the Gottlieb-Röse

method,[1] ammonia is added, and then alcohol, ether, and benzin; the lower layer forming under the clear ethereal solution contains all bacteria found in the milk. The layer is transferred to a conical, heavy glass tube, 10 cm. long, holding about 10 cc., and is placed in a metal cover fitting into the holes of the lactocrite disks and whirled. The residue forming at the sharp point of the tube is examined under the microscope for tubercle bacilli.—F. W. WOLL.

Water content of Schleswig-Holstein butter, O. HENZHOLD (*Milch Ztg., 23 (1894), No. 43, pp. 684, 685*).—The study of the water content of butter in Schleswig-Holstein, which was made by the experiment station at Kiel at the request of the Prussian Minister of Agriculture (E. S. R., 5, p. 952), included samples from private dairies and coöperative creameries in different parts of the province and from the station creamery, made in nearly every month of the year. In all, 101 samples were examined.[2] The 23 samples of dairy butter contained from 7.82 to 19.26 per cent of water, and averaged 12.77; and the 26 samples of creamery butter contained from 11.07 to 17.57, and averaged 13.66 per cent.

In order to observe the variations under normal conditions, 37 samples of butter were made by students in the Kiel dairy school, the water content being noted of the butter as taken from the churn, when worked once, and when salted and worked twice. This ranged for the finished butter from 5.90 to 16.81, and averaged 11.70 per cent. The butter was all made by approved methods, so that the difference in water content is believed to be due to the difference in makers, especially in working. In spring and summer the cream was churned at 10 to 12° C. (50 to 53.6° F.), and in fall and winter at 13 to 16° C. (55.4 to 60.8° F.).

In 15 other trials the effect on the water content of churning at too high a temperature or of overchurning was studied. The results follow:

Water content of butter churned and treated differently.

No. of sample.	Churning.			Water content of butter.			Remarks.
	Temperature.	End temperature.	Time.	As taken from churn.	Worked once (unsalted).	Worked twice and salted.	
	Deg. C.	*Deg. C.*	*Min.*	*Per cent.*	*Per cent.*	*Per cent.*	
1	12.0	13.5	29	21.48	18.93	15.08	Gathered for 3 minutes.
2	12.0	14.0	25	24.07	19.26	15.83	Gathered for 5 minutes.
3	12.0	13.5	30	21.77	20.45	15.39	Gathered for 3 minutes.
4	14.5	15.0	26	17.48	13.01	11.41	Do
5	15.0	17.0	22	17.77	14.98	13.41	
6	17.0	18.5	17	19.91	15.00	11.79	
7	17.0	18.5	22	29.56	29.18	18.32	
8	17.0	19.0	20	19.65	17.54	13.29	
9	17.0	18.0	30	18.66	15.93	12.25	
10	12.0	14.0	25	17.68	15.76	13.22	Butter left 2 days on ice.
11	14.0	15.0	25	16.38	15.05	13.31	Do

[1] Landw. Vers. Stat., 40, pp. 1–27.

[2] The water was determined by heating 10 to 12 gm. of butter in a porcelain dish with 20 gm. of broken pumice stone, as described by the author in Milch Ztg., 20 (1891), p. 71.

Water content of butter churned and treated differently—Continued.

No. of sample.	Churning.			Water content of butter.			Remarks.
	Temperature.	End temperature.	Time.	As taken from churn.	Worked once (unsalted).	Worked twice and salted.	
	Deg. C.	*Deg. C.*	*Min.*	*Per cent.*	*Per cent.*	*Per cent.*	
12				19.47	13.56	11.07	Churned at ordinary temperature.
13	20.0			27.67	21.38	18.08	Same cream as No. 12.
14				17.64	14.09	11.43	Milk separated at 35° C.; churning normal.
15				22.65	16.00	12.08	Churning normal; fresh butter kept in water at 25° C. for 18 hours.

The average water content, 13.73 per cent, was only 2 per cent higher than the average where the conditions were normal.

In the 101 samples the range was 5.90 to 19.26 and the average 12.96 per cent. Of the whole number, 13 per cent had over 15 per cent of water and 5 per cent had over 16 per cent.

The water content of East Prussian butter, R. EICHLOFF (*Milch Ztg., 23 (1894), No. 46, pp. 733, 734*).—From February, 1893, to October, 1894, an investigation was made of this subject by the dairy experiment station at Kleinhof-Tapiau, with the following results:

Water content of butter from different sources.

Butter.	Number of samples.	Minimum.	Maximum.	Average.
		Per cent.	*Per cent.*	*Per cent.*
Kleinhof-Tapiau creamery	36	8.52	15.34	13.29
Other creameries	6	10.66	13.37	11.95
Peasant butter	24	10.95	26.19	[1] 14.49

[1] In striking the averages all samples with over 20 per cent of water were excluded, "as it was assumed that either the churning took place under abnormal conditions or water had been purposely worked into the butter." As one fourth of the peasant butter had 20 per cent or over, the above average is not correct.

In addition to the above, the water was determined in unworked butter and in salted and unsalted butter worked once, with the following average results:

	Per ct. water.
Unworked butter	19.41
Worked once, unsalted	14.65
Worked once, salted	13.96
Ready for market	13.15

The loss of water in keeping butter packed in closed tubs in a cellar is shown as follows:

	Per cent.
Water in fresh butter	13.15
Water in butter 1 month old	12.08
Water in butter 4 months old	6.69

A sample of whey butter had 14.05 per cent of water.

Experiments in churning cream soured with hydrochloric acid, H. TIEMANN (*Milch Ztg., 23 (1894), No. 44, pp. 701, 702*).—Experiments with this method have been reported (E. S. R., 6, pp. 248, 249). Twenty one trials were made by the author at the request of Dr. Weigmann. The cooled separator cream was run into the churn and mixed with hydrochloric acid until the desired acidity for churning was obtained. The acid was made by diluting 1 part of pure acid of 1.124 sp. gr. with 2 parts of water. The water content of the butter worked once ranged from 13.31 to 17.42 per cent, and of the butter ready for market from 12.18 to 13.76 and averaged 12.65 per cent. The fat content of the buttermilk (undiluted) ranged from 0.45 to 1.02 per cent and averaged 0.76. This buttermilk could not be sold, so the acid was neutralized with bicarbonate of soda, 6 per cent of "common acid" (starter?) added, and after standing 24 hours run through the churn again. This buttermilk sold readily.

The butter had no aroma. The taste was pronounced "fair" to "good," but there was usually a slight aftertaste, and the butter was more or less oily. Some of the samples were entered at the butter exhibition in Hamburg when from 3 to 9 days old. They were pronounced by the judges from "medium" to "fairly good," although here the absence of aroma and the oiliness were mentioned.

Trials in which a strong acid was used were not satisfactory, as a disagreeable odor was developed.

Experiments in churning cream soured with hydrochloric acid, TAMM (*Milch Ztg., 23 (1894), No. 47, pp. 750, 751*).—A practical trial lasting 2 weeks was made of this method at a creamery. After some experiments an acidity of 12 to 13° (Soxhlet's), brought about by adding 5.5 cc. of hydrochloric acid per kilogram of cream, was adopted. The fat in the buttermilk ranged from 0.37 to 0.65 per cent. In all but 2 cases the butter was normal; it had a pure, clean taste, and had not changed in 14 days, but it had no aroma. It contained 2 to 3 per cent more water than butter made as ordinarily. No free hydrochloric acid was found. The author believes the method has advantages, but is not ready to recommend its general adoption until further trials have been made, which will follow with the aid of a pasteurizing apparatus.

On the vegetable cheese, "natto," K. YABE (*College Agr., Tokyo, Japan, Bul., vol. 2, No. 2, pp. 68–72*).—The author states that since remote times there has been prepared in Japan a sort of vegetable cheese called "natto," from the seeds of the soja bean. "The beans are first boiled in water for 5 hours to render them exceedingly soft. The still hot mass is in small portions wrapped in straw and the bundles thus formed, well tied at both ends, are then placed in a cellar, in the middle of which a fire is kindled, whereupon the cellar is well closed. The heat is left to act for 24 hours, after which the product is ready for consumption."

The author has found 4 kinds of bacteria in this cheese, and has studied the changes which they induce in the nitrogenous compounds in making the cheese. Considerable peptone, and also leucin and tyrosin were found, which are believed to be undoubtedly the result of bacterial action, and xanthin and hypoxanthin, which "probably were originally present in the soja bean." In conclusion the percentage of the different nitrogenous compounds in the beans and the natto is given as follows:

Nitrogenous compounds in soja bean and vegetable cheese.

	In soja bean.	In natto from same soja bean.
	Per cent.	*Per cent.*
Total nitrogen	7.355	7.542
Nitrogen in proteids (excluding peptone)	6.899	4.033
Nitrogen in amids	0.128	1.892
Nitrogen in peptone	0.328	1.617

Determination of the degree of ripeness and the fat content of cheese, C. VON MUZAKÖZY (*Ztschr. Nahr. Untersuch. und Hyg., 8, pp. 266–268; abs. in Chem. Centbl., 1894, II, No. 20, p. 851*).—The ripening of cheese, according to the author, consists principally in that a part of the casein which is insoluble in dilute acids changes to a soluble form. The digestibility of cheese has a direct connection with this solubility of the albuminoids. The disturbances from eating overripe cheese are due, he states, to the fat of the digestive fluids becoming saturated with soluble protein compounds. Hence he proposes to determine the ripeness of cheese by the amount of soluble albuminoids. To this end the broken up cheese, extracted of fat and dried, is used for determining ash and milk sugar, and another portion is washed on a tared filter with 0.5 per cent acetic acid, and the residue and its ash determined. From this the amount of soluble albuminoids is calculated. The fat is determined, according to Soxhlet's aërometric method, by treating 25 gm. of finely grated cheese with 160 cc. of water, 25 cc. of potassium hydrate, and 60 cc. of ether, and then proceeding as with milk.

The greening of Lombardy cheese and the cleaning of copper utensils, SARTORI (*Abs. in Milch Ztg., 23 (1894), No. 44, pp. 703, 704*).—Additional proof that the greening of cheese is due to the use of copper utensils which are brightly scoured with sand. Green cheese is said to sometimes contain 100 to 110 mg. of copper per kilogram, while the average is 22 mg. The copper is said to be in the form of hydrocarbonate (verdigris). When the vessels are not scoured with sand, but are scalded out with water an oxid soon forms which protects the copper, and not enough is dissolved to color the cheese. In some factories this has been adopted instead of scouring.

Biochemic investigations of ropy milk, N. BOCHICCHIO (*Staz. Sper. Agr. Ital., 27 (1894), No. 4, pp. 359–368*).—This is largely a study of *Bacterium hesii* and *Micrococcus freudenreichii* and of their effect on various solutions.

A convenient milk sampling tube, M. A. SCOVELL (*Agl. Sci., 8 (1894), No. 6–9, pp. 355, 361*).—The apparatus consists of a long copper tube about three fourths inch in diameter, sliding into a cap closed at the lower end. This cap has 3 elliptical openings in the sides. In taking the sample the cap is drawn partly off so that the apertures are opened. The tube is then inserted in a can of milk and the inner tube pushed down into the cap, closing it, and holding a column of milk.

This tube was used in connection with the test of breeds at the World's Fair. Tables are given showing its accuracy. It is claimed that the tube will take a fair average sample of the milk as milked from the cow without mixing, even after standing some time.

A review of the bacteriology of cheese, N. BOCHICCHIO (*Staz. Sper. Agr. Ital., 27 (1894), No. 4, pp. 434–445*).

Ventilation of cheese cellars, W. HELM (*Milch Ztg., 23 (1894), No. 50, pp. 795, 796; No. 51, pp. 813–815; No. 52, pp. 828, 829; also Molk. Ztg., 8 (1894), No. 50, pp. 765–767; No. 51, pp. 785, 786*).

AGRICULTURAL ENGINEERING.

Massachusetts College barns (*Massachusetts Agl. Col. Rpt. 1894, pp. 44–51*).—The new farm buildings of the Massachusetts Agricultural College, recently completed at a cost of about $35,000, consist of a horse barn, 41 by 91 ft., and a large storage and cattle barn. These buildings are frame with steel roofing, are lighted by electricity, and were constructed with special reference to the welfare of the animals and the saving of labor in feeding the stock and handling the manure.

The main part of the cattle barn is 141 by 61 ft., and consists of a basement and two stories. The topographical condition of the site allowed a driveway of an easy grade to be constructed at the east end, leading to the upper floor, 22 ft. above the main floor. This enables the storage of hay, silage, grain, stable absorbents, and bedding with the minimum amount of labor. At the western end 20 ft. of the loft is floored over so that wagons can be turned around and driven out by the east door, as the floor at the west end is 31 ft. above the ground.

On the right of the interior driveway, which is 14 ft. wide, are traps communicating with large bins for grain, a set of Fairbanks hay scales, and ample space for the operation of heavy barn machinery, where are placed a 15-horsepower electric motor, silage cutter, cornsheller, grain mill, thresher, etc. Further on are 3 silos which extend to the basement and will hold 425 tons of silage. The rest of that side, together with nearly all of the space on the left of the driveway, is occupied by haymows, in which 240 tons of hay can be stored.

The folding door shown on the south side near the east end, opposite which is a similar door, is approached by a very easy-graded driveway held by a curved retaining wall, and admits to a floor 11 ft. wide and 12 ft. above the main floor. Below this cross floor is a very capacious vegetable cellar, reached by traps in the cross floor and through a

door on the main floor. From this driveway access is also had to the second floor of the granary. When not otherwise in use this cross floor is occupied by carts, wagons, etc. The main basement is also used for the storage of implements and machinery.

Inspection of the photograph and plan will give an idea of the arrangement of the cow stable, which is 135½ by 43 ft., but there are several features that should be specially mentioned. The roof is of steel, under which is building paper and boards, then a 6 in. air space, then building paper and matched boards, then an inch and a half air space and then lath and plaster. All the ceilings and the wall of the monitor roof are of adamant cement, painted, and the walls of the stable are of matched North Carolina pine sheathing, oiled. There is no basement, and the cement passages and gutters are built upon solid earth and masonry. The gutters behind the cows incline toward the

FIG. 1.—Exterior of Massachusetts College stock barn.

center, where they empty into cisterns on either side of the building, thus saving all the liquid manure. By making the floor of the sheds at the south end 9 ft. below that of the stable it is convenient to carry all the solid manure in barrows and dump into carts or manure spreaders for immediate distribution. The stalls, of which there are 65, are fitted with a V-shaped cement feed and water trough, provided with movable dividing frames to permit of thorough cleansing.

Stanchions of various patterns are used in the stalls, but most of the animals are fastened with the Walters tie, arranged so that each animal may be liberated separately or entire sections at once by a single motion of the lever.

The upper windows are hinged at the bottom and moved by Ormsby's ventilating apparatus, the upper sashes of the lower windows being hinged at the bottom and moved individually by transom lifts, and the lower sashes are protected by iron gratings and slide into the partitions. Trapdoors, moved by cords and pulleys, are also placed in the cupolas. This arrangement secures perfect ventilation without

draft on the animals. There is 1,233 cu. ft. of air space for each animal kept in this building.

The arrangement of doors is such that hay, silage, grain, absorbents, etc., are conveniently brought from the main floor of the storage barn on trucks, and green food can be brought in on wagons through the south door.

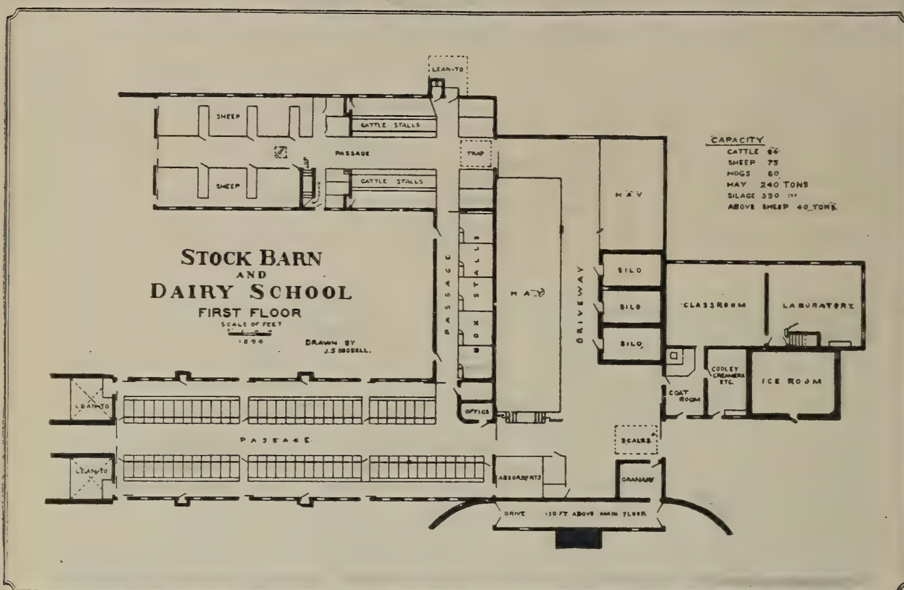

FIG. 2.—Ground plan of Massachusetts College stock barn—first floor.

A sheep barn 121 by 41 ft. is connected with the cow barn by a lean-to containing a passage and 5 box stalls fitted with plank mangers and Buckley's self-feeding watering devices. This barn contains 2 large and 5 small pens, sufficient for 75 sheep, stalls for 20 young cattle, and 4 stalls for bulls on the main floor; pigpens, slaughter room, root cellar, and swill room in the basement; and a loft large enough for 40 tons of hay. Doors open at the south end into dry and sheltered yards. The large sheep pens are provided with Hall's patent sheep racks. The cattle stalls are arranged like those in the other stable, except there are troughs of plank which have permanent partitions. The entire basement has a solid cement floor, which in the pigpens slopes to the center, where there are half-round gutters for carrying all the excreta to pits. About half of each pen has a raised plank floor, and the gutters are covered with hinged plank.

Ventilation is secured by similar devices to those used in the cow stables. Reference to the above plan and that on page 677 will show that the arrangement of doors and passages is such as to permit the passage of wagons on both basement and main floors.

The basement and one story northern extension (63 by 56 ft.) are devoted to dairy purposes. In the basement are boiler room, with 100-horsepower boiler which supplies steam and hot water for all purposes; engine room, in which there is a 75-horsepower engine, supply-

ing power to run the 616-candlepower alternator and 416-candlepower generator; ice room, holding 300 tons of ice; and separator and churn rooms.

On the main floor are a class room, laboratory, coat room, and upper part of ice room. The dynamos furnish electricity for lighting the farm buildings and the central college buildings, and for operating the large motor in the barn and the 7½-horsepower motor in the separator room, which is used for driving all dairy machinery. Sinks with hot and cold

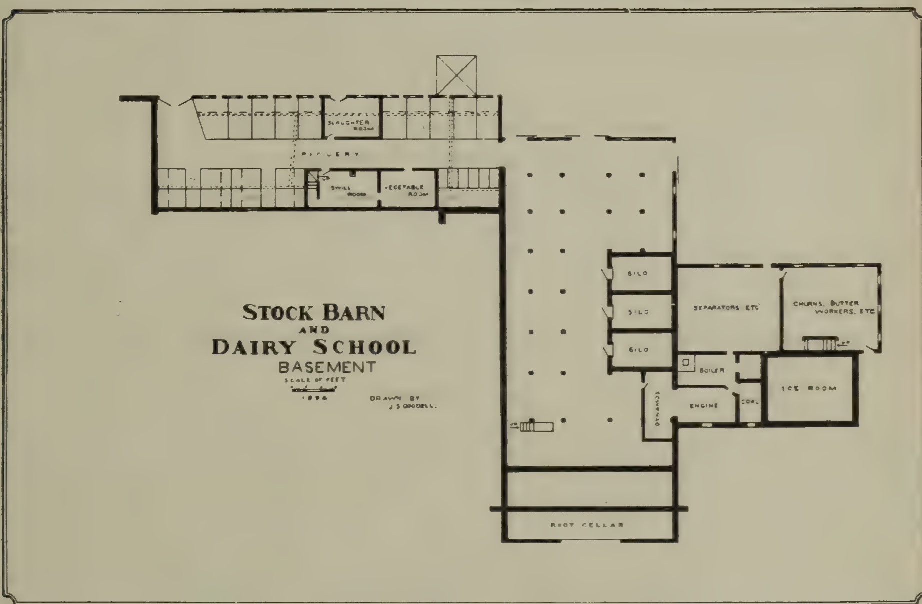

FIG. 3.—Ground plan of Massachusetts College stock barn—basement.

water and steam are in all parts of this building. The class room and laboratory are of ample size, well lighted and ventilated, and are well adapted to instruction in all branches of dairy work, including chemical and microscopic examination of milk and its products.

Proceedings of the National Road Conference, Asbury Park, New Jersey, July 5 and 6, 1894 (*U. S. Dept. Agr., Office of Road Inquiry Bul. 10, pp. 63, figs. 3*).—An account of proceedings, including the text of the various resolutions passed and addresses delivered by representatives from different States.

Roads and road making, D. O. NOURSE (*Virginia Sta. Bul. 34, pp. 137–139*).—Brief and simple directions for the improvement of dirt roads.

STATISTICS.

Annual Report of Florida Station (*Florida Sta. Bul. 24, pp. 31*).—Short reports by the director and heads of the several departments and substations, some of which are mentioned elsewhere.

Sixth Annual Report of New York Cornell Station (*New York Cornell Sta. Rpt. 1893, pp. 365*).—This includes a brief report by the director and members of the station staff, the treasurer's report for the fiscal year ending June 30, 1893, including a detailed statement of the receipts and expenditures, and reprints of the bulletins of the year.

Sundry investigations of the year (*New York Cornell Sta. Rpt. 1893, pp. 303–345, figs. 20*).—A reprint of Bulletin 61 of the station (E. S. R., 5, pp. 862, 867, 874, 879, and 883).

Imports of corn into Europe (*U. S. Dept. Agr., Division of Records and Editing Circular 147*).

NOTES.

ARIZONA STATION.—New substations have been established at Mesa and Yuma, the former in a block of 10 acres provided by the city, the latter upon a tract of land belonging to the Territorial prison. The prisoners will perform the labor required at Yuma.

MISSISSIPPI STATION.—The station has recently used the tuberculin test on a herd of 62 cows, mostly grade Jerseys, belonging to the agricultural college. Not a single suspicious case was found, the greatest rise in temperature being only 1 degree. Arrangements have been made for continuing the work with other herds in order to ascertain what foundation, if any, exists for the claim so often made by Southern stock breeders that cows raised in the South are less liable to tuberculosis than those grown in the North.

NEW HAMPSHIRE STATION.—Owing to the resignation of Professor Whitcher and Professor Wood and the burning of the farm barn, it will be necessary both to reorganize and to reequip the agricultural department.

PENNSYLVANIA STATION.—J. W. Fields, assistant chemist at the station, has resigned and accepted a position as consulting chemist with a firm of chemical fertilizer importers in New York City.

RHODE ISLAND COLLEGE.—College Hall, the main building of the Rhode Island Agricultural and Mechanical College, occupied as a dormitory and recitation rooms, was destroyed by fire January 27, 1895. The building was of stone, four and a half stories high, and cost about $45,000. A portion of the apparatus was saved, but much of the students' furniture and personal effects was lost. The State carried no insurance on the property. Temporary accommodations have been put up. It is proposed to erect a dormitory without recitation rooms on the site of the old building, and a drill hall 130 by 40 ft., the lower story of which will be devoted to chapel and recitation rooms, and the basement to carpenter shop for the mechanical department, bath rooms, etc.

IMPERIAL INTERNATIONAL EXHIBIT OF AGRICULTURAL MACHINES AT VIENNA.—The Imperial Agricultural Society of Vienna, under the patronage of His Imperial Highness the Archduke Carl Ludwig, will hold in Vienna on May 4, 5, 6, and 7, 1895, an international exhibition of agricultural machinery. The exhibition will be divided into the following departments: Agriculture and agricultural industries; forestry and forest industries; fruit and viticulture; animal industry; dairying; fish culture; veterinary work and horseshoeing; electricity as applied to agriculture and forestry; and an annex for seeds and artificial manures.

PERSONAL MENTION.—H. Molisch has been chosen professor of vegetable anatomy and physiology, and director of the institute of vegetable physiology of the University of Prague.

EXPERIMENT STATION RECORD.

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The act of Congress making appropriations for the United States Department of Agriculture for the fiscal year ending June 30, 1896, carries the following general items: For the Office of the Secretary of Agriculture, $94,140; Weather Bureau, $885,610; Bureau of Animal Industry, $812,000, including $12,000 for quarantine stations; Office of Experiment Stations, $30,000 ($15,000 is also appropriated for the continuance of the investigations on the nutritive value of human foods which are carried on through this office largely in coöperation with the agricultural colleges and experiment stations); Division of Statistics, $145,160, of which $10,000 may be expended in continuing the investigations concerning the feasibility of extending the demands of foreign markets for the agricultural products of the United States; Division of Entomology, $29,500; Division of Chemistry, $32,000, of which $5,000 is for the continuance of investigations of the adulterations of foods, drugs, and liquors, and $5,000 for the continuance of the investigations relative to the various typical soils of the United States, to determine their chemical characteristics, and especially the nature of the nitrifying organisms contained therein ($10,000 is also appropriated to continue experiments in the manufacture of sugar); Division of Botany, $33,800; Division of Forestry, $33,520; Division of Ornithology and Mammalogy, $27,560; Division of Pomology, $12,500; Division of Vegetable Physiology and Pathology, $26,500; Division of Microscopy, $7,300; Division of Agricultural Soils, $15,000; Division of Agrostology, $15,000; Division of Seeds, $199,120, of which $50,000 may be expended for the preparation, printing, and publishing of farmers' bulletins, two-thirds of which shall be supplied to Senators, Representatives, and Delegates in Congress for distribution among their constituents as seeds are distributed; Division of Publications, $8,300; for illustrations and engravings, $15,000; Document and Folding Room, $9,040; Division of Accounts and Disbursements, $17,300; library, $6,000; museum, $5,400; experimental gardens and grounds, $32,000; irrigation investigations, $15,000; inquiries relating to public roads, $10,000; furniture, repairs, postage, and contingent expenses, $37,000; total, $2,578,750. The act also contains an appropriation of $720,000 for the agricultural experiment stations established under the act of Congress of March 2, 1887.

It will be observed that under this appropriation act a new division will be established in the Department, namely, the Division of Agrostology, which will conduct field and laboratory investigations relating to the natural history, geographical distribution, and uses of the various grasses and forage plants and their adaptability to special soils and climates; and that the Division of Agricultural Soils, which has hitherto been connected with the Weather Bureau, will be an independent division. The Division of Records and Editing has added to its other duties the general charge of illustrations and the publication and distribution of farmers' bulletins. It will hereafter be designated as the Division of Publications.

The provisions of the act of Congress of March 3, 1891, relative to meat inspection have been amended so as to read as follows:

"SEC. 2. That the Secretary of Agriculture shall also cause to be made a careful inspection of all live cattle the meat of which—fresh, salted, canned, corned, packed, cured, or otherwise prepared—is intended for exportation to any foreign country, at such times and places, and in such manner as he may think proper, with a view to ascertain whether said cattle are free from disease, and their meat sound and wholesome, and may appoint inspectors who shall be authorized to give an official certificate clearly stating the condition in which such cattle and meat are found, and no clearance shall be given to any vessel having on board any fresh, salted, canned, corned, or packed beef being the meat of cattle killed after the passage of this act for exportation to and sale in a foreign country from any port in the United States until the owner or shipper shall obtain from an inspector appointed under the provisions of this act a certificate that said cattle were free from disease and that their meat is sound and wholesome.

"SEC. 4. That said examination shall be made in the manner provided by rules and regulations to be prescribed by the Secretary of Agriculture, and after said examination the carcasses and products of all cattle, sheep, and swine found to be free of disease and wholesome, sound, and fit for human food shall be marked, stamped, or labeled for identification, as may be provided by said rules and regulations of the Secretary of Agriculture. Any person who shall forge, counterfeit, simulate, imitate, falsely represent, or use without authority, or knowingly and wrongfully alter, deface, or destroy any of the marks, stamps, or other devices provided for in the regulations of the Secretary of Agriculture, of any such carcasses or their products, or who shall forge, counterfeit, simulate, imitate, falsely represent, or use without authority, or knowingly and wrongfully alter, deface, or destroy any certificate or stamp provided in said regulations, shall be deemed guilty of a misdemeanor, and on conviction thereof shall be punished by a fine not exceeding one thousand dollars, or imprisonment not exceeding one year, or by both said punishments, in the discretion of the court."

The Secretary of Agriculture is also authorized "to make such rules and regulations as he may decide to be necessary to prevent the transportation from one State or Territory or the District of Columbia into any other State or Territory or the District of Columbia, or to any foreign country, of the condemned carcasses or parts of carcasses of cattle, sheep, and swine which have been inspected in accordance with the provisions of this act."

AGRICULTURAL INVESTIGATION IN SWITZERLAND.

Dr. A. Grete,

Director of the Swiss Agricultural-Chemical Experiment Station of Zurich.

Agricultural investigation in Switzerland was until very recently comparatively undeveloped, if we exclude experiments conducted on private estates, which could scarcely claim to be of scientific value. The first attempts at a scientific treatment of important agricultural questions were made at the experiment station established in connection with the agricultural school of the Canton of Bern at Rüti, near the city of Bern, but for a long time this station did not do more than make analyses of various kinds, the real experimental feature being allowed to fall into the background.

At this period Schatzmann, director of the Dairy Experiment Station at Lausanne, materially advanced the cause of the dairy industry by lectures, consultations, etc., at various places, and also by maintaining a depot for dairy utensils for demonstration and for sale. For a long time after the death of Schatzmann[1] there was no conspicuous advocate of the dairy industry of Switzerland, and little was done in experimental inquiry at the Rüti Station, although that station had been extended to embrace dairy investigations. In 1887, however, there was a revival of this subject when Schaffer, Bondzynski, and Freudenreich commenced the publication in *Landwirtschaftliches Jahrbuch der Schweiz* of accounts of the following investigations:

By Schaffer: Concerning casein and the effect of rennet on cows' milk (1887); Contributions to the knowledge of the effect of rennet, and of the process of ripening of cheese (1888); Udder inflammation of cattle and its importance in agriculture (1888); Concerning the effect on milk of the internal use of bitter and aromatic medicines (1888). By Bondzynski and Rufi: Concerning the method of Werner-Schmid for the determination of fat in milk (1889). By Bondzynski: Concerning the nature of butter fat (1889). By Schaffer and Bondzynski: Concerning the physical and chemical changes of milk due to milk defects and udder inflammation in cattle and goats (1890). By Freudenreich: Concerning a new bacillus found in swelled cheese (1890).

At various times, and especially in the year 1882, steps were taken by the Swiss Agricultural Society to induce the general government to establish a federal dairy station for theoretical and practical work, but the carrying out of this plan has been deferred from time to time. Later

[1] The more important of Schatzmann's articles were published in the *Alpwirtschaftliche Monats-blättern.*

an attempt was again made to combine with the agricultural experiment station an animal industry station with the addition of the necessary land, principally for the carrying out of feeding experiments, and to establish an Alpine agricultural experiment station. The last projects are still far from realization, but a division for dairy investigations established in connection with the Agricultural Institute at Lausanne (Dr. S. Bieler, director) in 1889 has made notable progress.

By the decree of August 23, 1888, a dairy experiment station was established at the Lausanne Agricultural Institute in connection with the existing Wine Experiment Station (Dr. J. Dufour, director), and in September, 1888, an order issued by the Council of State of the Canton of Vaud provided that this station should consist of (1) a bureau for information, investigation, and technical expert opinion in the dairy industry; (2) a collection of apparatus and necessary utensils for dairying; (3) a chemical laboratory for investigations and experiments in dairying; and (4) a laboratory for experiments in the technology of dairying. Provision was made for an expert to direct the technical work in dairying, at a salary of from $600 to $1,000 per year; a chemist, at $600 to $1,000; a chemist's assistant, at $300 to $400; and a laboratory assistant, at $120 to $200.

This order further provided that the appliances of the station and its experiments and collections should be utilized for the purpose of agricultural instruction; and that practical cheese schools should be established in the cantons after consultation with the community or the society of cheese manufacturers.

The Department of Commerce and Agriculture was charged with the enforcement of this order, and with general supervision of the station, although the Council of State is responsible for its personnel.

The position of director was filled in April, 1889, and in November, 1889, the Dairy Experiment Station (Dr. G. Martinet, director) in connection with the Agricultural Institute of Lausanne was opened. Later an agricultural station (Dr. E. Chuard, director) was added to it.

The official journal for the Dairy Experiment Station was *Chronique Agricole et Viticole*, a monthly publication dating from the latter part of 1888. In 1891, however, there was added to this station a forestry experiment station, coöperating with the forestry experiment station at Zurich, and the name of the official organ was changed to *Chronique Agricole du Canton de Vaud.*

As regards viticulture, west Switzerland has had for a long time a school of instruction in the Viticultural Station of Lausanne, but not until 1891 did east Switzerland obtain such in the Experiment Station and School for Fruit, Wine, and Garden Culture, in Wädensweil, on the Lake of Zurich, conducted by Prof. Dr. Müller-Thurgau, both of these being cantonal institutions. During its short existence this experiment station has already done good service for native fruit and vine culture, especially in regard to vine and fruit tree management,

and wine and must improvement. The reports of the station appear in the *Sweizerische Zeitschrift für Obst- und Weinbau*, which, under the name of *Monatsschrift für Obst- und Weinbau*, was for twenty-five years the organ of the Swiss Fruit and Wine Culture Association.

A few years since an experiment garden for demonstration was acquired by the teachers of fruit and wine culture in the agricultural school of the Polytechnic Institute of Zurich, and the professor of agriculture has been provided with an experimental field at Strickhof, near Zurich.

The great development which the fertilizer industry has lately made in Switzerland has been accompanied by a similar expansion of official control. Prior to 1878 many domestic factories of artificial manures existed, and foreign firms shipped their product into Switzerland, but nowhere was there any control of their production, or, at least, only so far as individuals saw fit to have tests made at their own expense. It was, therefore, a step in the right direction when the so-called warehouse control was established. Under this system a chemist of the Polytechnic Institute undertook a partial inspection of fertilizers in the factories whose proprietors would consent to the investigation, and these results were made public. It is evident, however, that such a control offered no security to the purchaser, for the product found in the warehouse could be subjected to many changes before being sold to the farmer.

It was, therefore, a decided advance when in 1878 a federal agricultural control station for fertilizers and feeding stuffs, and a seed control station under separate direction, were established by the government, and authorized to arrange with the interested firms a system of control by which the farmer obtained the advantage of a free examination of the purchased goods. To these federal stations two cantonal stations have been added, an experiment farm at the Agricultural Institute at Lausanne, and a station at Rüti near Bern, coöperating with the Chemical Experiment Station of Bern (Prof. Dr. Rossel, director). The latter had been organized the previous year and is confined to the Canton of Bern and the surrounding country, while the federal institution extends its work over all the cantons of Switzerland, including Bern. Recently the work of the station has been extended to include especially culture tests of soils, and for this purpose an experiment garden with greenhouses adapted to pot culture has been provided.

The Federal Seed Control Station and the Agricultural Experiment Station of Zurich were established by a resolution of the federal council of March 17, 1877, at the federal Polytechnic Institute at Zurich. They were placed under the supervision of the Swiss school council, which, since 1885, has exercised its control through a supervisory commission. The management of each of these stations is intrusted to a director chosen by the federal council, who, with his assistants, transacts the current business.

THE FEDERAL SEED CONTROL STATION.

The extraordinary encouragement this station received from the farmers and the dealers of Switzerland and foreign countries caused a rapid growth of the institution and made enlargement of accommodations and working force necessary. At present there are in the station the director (Dr. G. Stebler), 1 male assistant, 6 female assistants, and 1 clerk. The seed control station is now located in the chemical building of the Polytechnic Institute and is well supplied with all apparatus and other material necessary. It possesses besides a greenhouse for the carrying on of germination experiments, a small experiment field near by for culture tests, and two more distant experiment fields, one near Pfäffikon, for the culture of litter plants, and the other on the Fürstenalp at Graubünden, for Alpine culture.

The following table shows the work of the years 1879–'93:

Work of Swiss Seed Control Station.

Years.	Firms under contract.	Number of packages.	Control tests.
1879	31	1, 056	867
1880	36	1, 343	903
1881	46	1, 465	400
1882	53	1, 792	390
1883	53	1, 809	625
1884	55	1, 883	432
1885	50	1, 877	458
1886	56	2, 247	655
1887	60	2, 74[illegible]	759
1888	58	3, 150	(?)
1889	67	4, 009	1, 176
1890	64	4, 611	1, 323
1891	72	4, 849	1, 486
1892	73	5, 579	1, 365

The annual reports of the seed control station appear in *Schweizerische landwirtschaftliche Zeitschrift*.

The scientific work of the station is directed principally to the investigation of forage plants and to culture tests on the experiment fields.

The following articles, for the most part jointly prepared by Dr. Stebler and Prof. Dr. Schröter, have appeared in *Landwirtschaftliches Jahrbuch der Schweiz:*

Contributions to the knowledge of meadows and pastures of Switzerland: Method and object of the investigation of meadows and pastures of Switzerland (1887); Investigation concerning the influence of manure on the structure of the stigmas of meadow grasses (1887); Concerning the influence of irrigation on the structure of the stigmas of meadow grasses (1887); Influence of grazing on the structure of turf (1887); A heavy yielding form of French rye grass (1888); Influence of the size of the seed kernel on the yield of green fodder by white horse tooth corn (1888); Borst grass (*Nardus stricta*), a bad enemy of our Alpine agriculture (1888); and The Fürstenalps and the culture of forage plants on the Alpine experiment field of the same (1889).

THE SWISS AGRICULTURAL-CHEMICAL EXPERIMENT STATION OF ZURICH.

In the early history of this station the director gave the closest attention to the development of the control relation between the station and the merchants, and also to increasing the efficiency of the control. It was obvious that a thorough inspection of all the fertilizers and feeding stuffs which came on the market could not be obtained by pressure from the station, so the attempt was made to induce the business houses to voluntarily submit all their goods to inspection by the station, under a contract by which the purchasers could afterwards have the goods examined by the station free of cost, and which bound the firms to pay indemnity to the purchaser should the wares prove to be below the guaranteed grade.

On the basis of such a contract the purchasers are offered fertilizers and feeding stuffs of guaranteed composition, with a free control analysis, provided they fulfill certain formalities as to drawing the sample, packing the same, witnesses, etc. In case the goods fall below the guaranty, the contracting firms, so-called "control firms," agree to pay the purchaser an indemnity depending upon the extent of the shortage. If the shortage is within certain limits, given below, the indemnity is only partial and is fixed by a prescribed tariff; but if the shortage exceeds these limits the indemnity covers the total value of the shortage. The limits are as follows:

	Per cent.
In fertilizers:	
For phosphoric acid and potash	0.5
For nitrogen in fertilizers containing 5 per cent or more	0.5
For nitrogen in fertilizers containing less than 5 per cent	0.3
In feeding stuffs:	
For protein	2.5
For fat	0.5

The value of the excess of one constituent may, to a certain degree, be used as an offset to the indemnity required for shortage of another, provided the above limits are not exceeded; otherwise indemnity may be demanded to the full value of the shortage.

For the convenience of the purchaser a certificate is given by the factory, which, after being filled out by the purchaser and the witnesses of the sampling, entitles him to a subsequent examination of the sample free of charge. Nevertheless, the purchaser can without special permission from the factory, by right of one of the regulations, have an examination of the goods made by forwarding to the station the invoice with certificate of witnesses of the sampling.

The station also twice a year makes known to the farmers the price list of all the "control" firms, warning them that the fertilizers and feeding stuffs of these firms only will be given free control analyses by the station. The results of the examinations are officially reported to those sending samples.

The equipment of the station.—The station was originally installed in a small room of the agricultural school, but it has gradually spread itself into a large number of workrooms. Hand in hand with this expansion, there has been a steady increase of the working force until, at the present time, the personnel of the station consists of a director (Dr. A. Grete), 5 permanent assistants, 2 clerks, 1 helper, and 1 botanical assistant, besides 5 temporary assistants employed during the spring.

For such extended work the old apartments in the agricultural school of the Polytechnic Institute were not sufficient, and consequently in 1886 new quarters were secured in the new federal chemical building. The experiment station was assigned the entire first floor, about 98 feet long and 33 feet wide, and the larger part of the basement.

The first floor contains the director's office, to which is attached his private laboratory; a dark room for spectroscopic and similar work; a large room for collections, and a smaller one used for storage of the delicate apparatus, and also, since 1890, for the microscopic examination of the feeding stuffs, under the charge of a special botanical assistant; and various laboratories so arranged that each investigation which the station is most frequently called upon to make may have its special department, devoted to its special purpose and equipped according to the needs of the case. This arrangement relieves the other laboratories of all determinations not directly bearing on the investigations to which they are devoted. One laboratory is devoted almost exclusively to the determinations of water-soluble phosphoric acid, the solutions being made in the cellar and sent direct to the chemist, for analysis, by means of an elevator. This laboratory has lately been provided with a large revolving titration machine, which is arranged to simultaneously titrate 10 samples with molybdic acid solution, as described by the author in *Berichte der deutschen chemischen Gesellschaft.*

There is also a large and well-equipped general laboratory in which chiefly determinations of phosphoric acid insoluble in water are made. This laboratory is furnished with 3 double worktables, standing in the middle of the room, and 4 hoods. Each assistant is thus provided with a hood, under which is arranged a sand and water bath. This laboratory is also provided with a blast, driven by a water motor, and has distilled water on tap at two points.

A similarly equipped laboratory is set apart for potash determinations, although it is often utilized for some other purposes. The atmosphere of this room is kept ammonia-free. A room opens off this large laboratory which is furnished principally with the apparatus required for nitrogen determinations. In hoods are the necessary furnaces, ovens, etc. On a large table in the middle of the room are arranged distilling apparatus[1] and condensers, and racks with standard solutions for titrating.

[1] As distillation flasks, the so-called Erlenmeyer flasks of tinned copper, first suggested by the author, have been used for a long time with excellent results.

Adjoining these 3 laboratories is the weighing room, which has space for 12 balances. Here, also, is a small library of reference books needed in ordinary laboratory work.

The washing of apparatus is done in a special wash room.

In a room adjoining the general laboratory the purely clerical work is done. The assistants prepare detailed reports of results on small sheets at their worktables, fasten these sheets together, and hand them into the record room, where they are entered in special books bearing the numbers of the assistants.

The basement space allotted to the station is devoted principally to appliances for drying and preparing samples for analysis, force pumps, distillation apparatus, storage, and a technological laboratory.

Coarse fodders are prepared for analysis by being passed through a cutting machine, and after thorough drying finely ground by a Grüson Excelsior mill. Granular, dry, not too hard materials are immediately put through the same machine. The finest powder is prepared by the Dreefs mill. With superphosphates these machines can not be used, as their iron parts are attacked by the acid, and the final results might be affected. For these materials a mill in which the fertilizer comes in contact only with porcelain has been devised, which has given excellent results. These mills are all operated by a water motor.

The still used was made from special designs by the author, and is arranged not only to distill liquids directly or with steam, but to rectify them at the same time. The same apparatus is also arranged to accommodate evaporating dishes of different sizes, and may be connected with a vacuum, without, in most cases, interfering with the distillation of water or other solutions.

All the apartments are provided with complete electrical service.

The work of the institution.—Convinced of the security afforded by the above described control of fertilizers and feeding stuffs, the farmers have year by year more fully availed themselves of the privilege of having the guaranties accompanying purchased goods confirmed by the station analysis, so that at present in many localities no one thinks of using fertilizers on a large scale without taking advantage of such examinations. For this reason the number of analyses each year is very large.

In the year 1878 only 47 samples were received for examination. The numbers received during succeeding years were as follows:

Summary of station work.

Years.	Investigations.	Quantitative determinations.	Free control analyses.
1879	180	640	57
1880	254	920	94
1881	604	2,090	316
1882	690	2,800	438
1883	642	2,762	389
1884	803	4,419	457
1885	900	5,005	652
1886	1,140	6,250	926
1887	1,260	6,881	980
1888	1,323	7,604	1,077
1889	1,595	9,108	1,237
1890	1,867	10,012	1,333
1891	2,296	12,727	1,678

The number of "control firms" who gave the farmers the right to free analysis was as follows:

Number of control firms.

Years.	Fertilizer firms.	Feeding stuff firms.	Total.
1878	5	0	5
1879	10	3	13
1880	12	4	16
1881	17	6	23
1882	19	5	24
1883	20	7	27
1884	20	7	27
1885	24	10	34
1886	22	6	28
1887	22	6	28
1888	20	5	25
1889	20	5	25
1890	23	5	28
1891	23	6	29

Besides this annual routine analytical work the station has carried out a series of scientific practical investigations, among which are the following reported by Dr. Grete in articles published for the most part in *Landwirtschaftliches Jahrbuch der Schweiz*, 1887–'88: Experiments concerning the proper time to cut hay; Investigations of the composition of Swiss litter plants; Investigations concerning liquid manure; Experiments concerning the preservation of green food by means of carbon bisulphid; Concerning the extract in wine;[1] Determination of phosphoric acid by titrating with molybdic acid;[2] Report on the results of fertilizer experiments conducted in Switzerland in 1885 and 1886; and Investigations of the Swiss barks used for tanning.[3]

[1] Ber. deut. chem. Ges., 1880, p. 1171.

[2] Ibid., 1888, p. 2762.

[3] Mitt. Schweiz. Controlanstalt forst. Versuchswesens, 1, No. 1.

RECENT WORK IN AGRICULTURAL SCIENCE.

CHEMISTRY.

A digestion flask for obtaining the acid solution in soil analysis, H. SNYDER (*Minnesota Sta. Rpt. 1893, pp. 248–251, figs. 2*).—Digestion in porcelain beakers as proposed by Hilgard is open to the objection that the acid partly evaporates and consequently varies somewhat in strength, and in using the stoppered bottles recommended by Kedzie "it is difficult to obtain bottles that will stand so high a pressure for so long a time, and it requires a very perfect-fitting stopper to prevent any interchange between the hot solutions in the water bath and the acid in the bottles."

"The flask [proposed by the author] has a capacity of 100 cc. The ground-glass stopper is provided with an exit tube that can be connected with a small glass tube or a condenser. . . .

"A compact form of condenser can be made from a galvanized iron pail by perforating the bottom with holes a little larger than the glass tubes that are to be inserted, and making the joints water-tight by means of rubber tubing. Long glass tubes can be used without any condensing apparatus. A cover is also provided for the water bath with small openings to allow the condensing tubes to pass through.

"The soil is weighed direct into these digestion flasks, and the proper amount of acid added. The flasks are then placed in the water bath and connected with the condensers. At the end of the fourth day the solution and insoluble residue is transferred to a casserole, and all of the remaining determinations are made in the usual way."

The results of comparisons of the three methods on soils of different character are reported.

"Under the same conditions the digestion flasks and the glass-stoppered bottles give practically the same results, with the advantage as to rapidity and less liability of losses in favor of the digestion flasks. Both of the methods give higher results for the potash and the alumina than the covered beaker. This is due to the action of the acid upon the soils at a more uniform temperature and maintaining the acid at its initial strength."

A new gasometric method for determining nitrogen in nitrates, F. GANTTER (*Ztschr. analyt. Chem., 34 (1895), No. 1, pp. 25–32, fig. 1*).—The method is based upon the facts that (1) nitrates are reduced to nitrites when heated in concentrated solution with phosphorous and sulphuric acids, and (2) when nitrite solutions are heated with ammo-

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nium chlorid the nitrogen of both the nitrite and the ammonium chlorid is set free, as shown by the following equations:

$$N_2O_5+P_2O_3=N_2O_3+P_2O_5.$$
$$N_2O_3+2NH_4Cl=2N_2+3H_2O+2HCl.$$

The method is conducted as follows: Three cubic centimeters of a solution which should contain not more than 300 mg. of nitrate with 500 mg. each of crystallized ammonium chlorid and crystallized phosphorous acid are placed in the digestion flask of a special form of gas generator which is described, and 2 cc. of sulphuric acid (2 parts of concentrated sulphuric acid and 1 of water) is added. The digestion flask is provided with a pipette in its mouth, in which 5 cc. of sulphuric acid (2 to 1) is placed, and is also connected with an absorption apparatus containing soda solution for purifying the nitrogen generated. This apparatus is placed in a cooling cylinder and the generating flask very slowly and carefully heated with the smallest possible flame. This soon produces a slow and uniform evolution of gas, which gradually increases, so that after a time the flame must be removed in order to check the too rapid generation of gas. The latter should be so regulated that the solution is not colored yellow, and when it has almost ceased the sulphuric acid in the pipette is allowed to run into the flask, which is warmed again and the solution gradually raised to the boiling point. This is continued until no further evolution of gas takes place, when the solution is strongly heated for a few minutes. This heating, however, must not be continued so long that the solution in the flask becomes colored by the concentration of the sulphuric acid. The nitrogen evolved is collected in a eudiometer over water and measured.

Accurate results were obtained by this method or modifications of it on nitrate of soda, nitrate of ammonia, nitrate of potash, nitrite of soda, and drinking water.

In applying the method to the examination of nitrate of soda 300 mg. each of phosphorous acid and ammonium chlorid instead of 500 mg. is used.

The method can be employed in the determination of very small amounts of nitric acid, and hence is applicable to the examination of drinking water. In this case the residue from the evaporation of 500 cc. of water is taken up in a little water and filtered into the digestion flask, in which the filtrate is evaporated nearly to dryness. To the residue 2 cc. of dilute sulphuric acid (2 to 1) and 100 mg. each of ammonium chlorid and phosphorous acid are added, and the operation conducted as above described.

On a new volumetric method for determining phosphoric acid in pure solutions, R. SEGALLE (*Ztschr. analyt. Chem., 34 (1895), No. 1, pp. 33–39*).—Various methods proposed for this purpose are briefly reviewed, and determinations by gravimetric analysis, volumetric

analysis (using phenolphthalein as an indicator), by R. Maly's method [1] (original and modified), and by C. Glücksmann's method (as modified by J. Langer [2]) are reported.

The results are favorable to the Glücksmann method as compared with the others tested, and this method is recommended for adoption as a standard volumetric method, being especially valuable for pharmaceutical chemists.

Argon, a new constituent of the atmosphere, Lord RAYLEIGH and W. RAMSEY (*Chem. News, 71 (1895), No. 1836, pp. 51–63*).

The synthesis of albuminoid compounds, LILIENFELD (*Rev. Scientif., 1895, No. 3, p. 87*).—A notice of an article read before the Biological Society of Berlin.

A study of the vegetable alkaloids, E. ARMENDARIS (*Mem. Rev. Soc. Cient. "Antonio Alzate," 8 (1894–'95), No. 1 and 2, pp. 11–29*).—The method employed and the results obtained in a detailed study of these compounds are reported.

On the chemistry of chlorophylls, E. SCHUNCK and L. MARCHLEWSKI (*Liebig's Ann. Phys. und Chem., 284, No. 1 and 2, pp. 81–107*).—A second paper, the first being published in the same journal, vol. 278, p. 329.

On the determination of iron oxid and alumina in mineral phosphates, W. HESS (*Ztschr. angew. Chem., 1894, No. 22, pp. 679–683*).

On a new method of determining fat in milk, P. FERNANDEZ-KRUG and W. HAMPE (*Ztschr. angew. Chem., 1894, No. 22, pp. 683–687*).

Improved laboratory apparatus, J. VOLHARD (*Liebig's Ann. Phys. und Chem., 284, No. 1 and 2, pp. 233–244, figs. 5*).—The apparatus described include a water bath with constant level, oven for heating sealed tubes, and a gas furnace for elementary analysis.

Volumetric and colorimetric analysis, W. H. SYMONS (*Pharm. Jour. and Trans., 54 (1895), No. 1284, pp. 652–655, fig. 1*).

The scientific principles of analytical chemistry, W. OSTWALD (*Die wissenschaftlichen Grundlager der analytischen Chemie. Leipzig: W. Engelman, 1894*).—Reviewed in *Phil. Mag. and Jour. Sci., 39 (1895), No. 237, p. 225.*

Notes on the Grandeau method for humus, H. SNYDER (*Minnesota Sta. Rpt. 1893, pp. 251–254*).—This is a reprint of an article first published in *Jour. Amer. Chem. Soc., 16 (1894), No. 3, pp. 210–213* (E. S. R., 5, p. 932).

Methods of determining sugar and starch, J. M. BARTLETT (*Maine Sta. Rpt. 1893, p. 37*).—A detailed description is given of the individual methods with acid and with diastase.

Agricultural chemical contributions, V. STEIN (*Tidsskr. Landökon, 12 (1894), pp. 857–867; 13 (1894), pp. 722–737*).—A summary of agricultural-chemical work performed for the Royal Danish Agricultural Society during 1894.

BOTANY.

Grasses of Tennessee, II, F. LAMSON-SCRIBNER (*Tennessee Sta. Bul., vol. VII, No. 1, pp. 141, figs. 187*).—Part I of the Grasses of Tennessee,[3] when issued, was intended as preliminary to the part here presented, but considerations led to a modification of this plan and the present bulletin is complete in itself, and, as the author says, "may be called a handbook of the grasses of Tennessee." Descriptions of all the

[1] Ztschr. analyt. Chem., 15, p. 417.

[2] Pharm. Post., 27, pp. 369–371 (E. S. R. 6, p. 610).

[3] Tenn. Sta. Bul., vol. v, No. 2 (E. S. R., 4, p. 249).

genera and species known to occur within the State are given, and under the specific descriptions are added economic notes whenever they would be of value or interest. In the descriptions of the tribes and genera notes are given on their numerical abundance and geographical distribution throughout the world, from which their relative representation in the region covered by the bulletin may readily be seen. There are more than 200 species and varieties of introduced and indigenous grasses described, representing 65 genera of 11 tribes, and most of them are figured, some for the first time. The illustrations, which were especially prepared for this work, show the general habit of the plant, the inflorescence and dissections of the spikelets, the latter being drawn to a larger scale than those showing the entire plant. For nearly every genus of more than a single species an analytical key of species is given that will materially aid in the determination of specimens. A feature of the bulletin is the index and glossary in which every scientific name and technical term used is concisely defined, in addition to the usual references to figures and pages. The most widely known common name of each species is given, and the scientific nomenclature is not burdened with a list of synonyms that are valuable only to a specialist. The nomenclature followed is in the main that used in the manuals covering the same region. The bulletin, while containing only the grasses of Tennessee, will be valuable to most of the eastern and central part of the United States, the region covered by Gray's Manual, the edition of 1890 of that work containing less than a score of genera not included in this bulletin.

Notes on maize, E. L. STURTEVANT (*Torrey Bul., 21* (*1894*), *No. 12, pp. 503–523*).

Synopsis.—Notes are given on crossing of species, crossing of varieties, mummy corn, effect of climate on the growth, growing season required for corn, and the physiology of pop corn.

The author thinks from the data given that it is highly probable that cross-fertilization is very common, at least within each species, but that there is some resistance to hybridization; however, more data are required before claiming the demonstration of the generalization. Within varieties color variation is very common. Descriptions are given of 4 varieties of mummy corn, 3 of which are from Peru, the other from Chile. All belong to the species *Zea amylacea*. The author offers a few generalizations on the effect of climate on corn. He says the common belief that a northern climate increases earliness and decreases size is not borne out by his observations, and the idea that we must go North for seed is untenable except that in the North are found only varieties maturing within certain periods. He thinks earlier corn must be sought by finding earlier varieties, whether in the North or South. The author gives as an explanation of the phenomenon of corn popping the fact that hot water causes starch to become plastic. In the pop corn the starch lies within a very tough endosperm and the applica-

tion of heat causes the starch to swell; the liberated steam bursting the grain, exposes the white fluffy mass of swollen starch. In the case of the nonpopping corns, the endosperm is too thin and only splits to liberate the steam. Aboriginal names are given for parched or variously prepared kinds of corn.

Pentosans in plants, G. DE CHALMOT (*Amer. Chem. Jour.*, *16* (*1894*), *pp. 589–611*).—The author found from 80 to 90 per cent of furfurol-yielding compounds in barley sprouts germinating in darkness, and separated from them a pentosan which yielded pentose on inversion. His investigations indicated that these furfurol-yielding bodies belong to the nitrogen-free extract, and are not derived from the cellulose, as suggested by Cross and Bevan. It is claimed that the fact that cane sugar interferes with the phloroglucol reaction explains the failure of these investigators to find pentosans in barley sprouts grown in darkness.

The author found that the amount of pentosans increased in germinating corn with the advance of germination. The amount in peas first increased, then decreased. Both in corn and in peas the amount in the seeds proper decreased, and that in the stems and roots steadily increased during germination. The increase of pentosans in the stems and roots of peas (and clover) is, however, not nearly so pronounced as that in the stems and roots of corn.

The author holds that the pentosans in the roots and stems are not derived from the seeds, but are formed from other plant constituents.

The amount of pentosans in the germs is but slightly affected by the presence or absence of light during germination.

In connection with the discussion of this topic a table is given showing percentages of pentosans found in seeds by the author and others.

Extensive experiments showed that nitrates supplied to the germinating corn increased the amount of pentosans dissolved from the seed. At the same time the stems and roots were poorer in pentosans but richer in albuminoids, the influence of the nitrates in this respect being very pronounced.

It was also observed that the pentosans of pine wood increased during growth, a fact which is in accordance with results obtained with all other growing parts of plants.

The evidence supporting the author's hypothesis that pentosans are not the result of the processes of assimilation but are formed from hexoses is discussed in detail.

Influence of drying on the respiration of tubers, J. F. LUND (*Rev. gén. Bot.*, *6* (*1894*), *No. 69*, *pp. 353–355*).—The author has investigated the tubers and fleshy roots of artichoke, onion, radish, potato, and carrot. It was found that specimens ripened and kept over winter decreased in their respiration with their decrease in weight due to desiccation. In the case of young tubers collected in April or May that were formed during the season there was a slight increase in their respiration following a slight loss of water.

A manual of orchidaceous plants (*Chelsea: Jas. Veitch & Sons, 2 vols., pts. 10*).

Notes on Antigua grasses, C. A. BARBER (*Suppl. Leeward Islands Gaz., 1894, No. 32, pp. 165–170*).—Popular notes are given on Guinea grass (*Panicum jumentorum*), *Andropogon caricosus*, Bermuda grass, *Andropogon saccharoides*, and *Sporobolus indicus*.

The philosophy of flower seasons and the phenological relations of the entomophilous flora and the anthophilous insect fauna, C. ROBERTSON (*Amer. Nat., 29 (1895), pp. 97–117, pls. 3*).

Sensitive movements of some flowering plants under colored screens, J. M. MACFARLANE (*Bot. Centbl., 61 (1895), No. 4, pp. 136–146; No. 5, pp. 177–184*).

Concerning heliotropism, W. ROTHERT (*Cohn's Beiträge Biol. Pflanzen, 7 (1894), No. 1; abs. in Bot. Ztg., 53 (1895), II, No. 2, pp. 17–25; also Bot. Centbl., 61 (1895), No. 4, pp. 159–166*).

The discussion concerning the function of the root tips, W. ROTHERT (*Flora, 79 (1894), pp. 179–218; abs. in Bot. Centbl., 61 (1895), No. 5, pp. 199–200*).—A critical review of the literature relating to the subject.

The thorns of plants, H. COUPIN (*Pop. Sci. Monthly, 46 (1895), No. 4, pp. 498–501*).

The continuity of protoplasm in plants, R. BEER (*Nat. Sci., 6 (1895), No. 36, pp. 108–111*).—A review of the theory of continuity of protoplasm and a short bibliography of some of the more important contributions to the subject.

Mold and other growths found in the seed cavities of apples, L. MOORES (*Amer. Micr. Jour., 16 (1895), No. 2, pp. 49–54, figs. 2*).—The author reports the common growth found in seed cavities to be internal hairs. A *Penicillium* sometimes gains access through large openings at pip end or more commonly through insect burrows.

The coloring of apples (*Gard. Chron., 17 (1895), ser. 3, pp. 177, 178*).—A controversial article on the relative importance of direct sunlight and soil constituents on the production of high colors.

FERMENTATION—BACTERIOLOGY.

The microörganisms of fermentation, A. JOERGENSEN, translated by P. FREUND (*Les Microrganismes de la fermentation. Paris: 1895, pp. 318, figs. 56*).—Reviewed in *Rev. Scientif., 10 (1895), No. 3, p. 83*.

Recent researches on pectase and pectic fermentation, G. BERTRAND and A. MALLÈVRE (*Compt. Rend., 120 (1895), No. 2, pp. 110–112*).

The bacteria of drinking water, especially of the Chemnitz water supply, O. E. R. ZIMMERMANN (*Zwölfter Ber. Naturw. Ges. Chemnitz, pp. 79–168, pls. 5*).

A simple apparatus for disinfecting with steam, L. VAILLARD and BESSON (*Ann. Inst. Pasteur, 8 (1894), No. 12, pp. 833–853, figs. 5*).

ZOÖLOGY.

Are all birds of prey injurious to the farmer? E. A. SMYTH, Jr. (*Virginia Sta. Bul. 38, pp. 23-39*).—This bulletin consists of notes on the feeding habits of the common hawks and owls of Virginia, with the results of the examination of numerous stomachs of each species. Much of the matter is compiled from "Hawks and Owls of the United States."[1] The following species are treated of, brief descriptions and notes on the habits being included: Marsh hawk, sharp-shinned hawk, Cooper's hawk, goshawk, red-tailed hawk, red-shouldered hawk, broad-winged hawk, rough-legged hawk, golden eagle, bald eagle, duck hawk,

[1] U. S. Dept. Agr., Division of Ornithology and Mammalogy Bul. 3 (E. S. R., 4, p. 852).

pigeon hawk, sparrow hawk, fishhawk, barn owl, long-eared owl, short-eared owl, barred owl, screech owl, and great horned owl. The positive economic benefit of many of these species is urged.

Two tables are appended, one giving a résumé of the lists of stomach contents for each species, and the other giving the percentages of poultry or game, mice, and insects found in the food.

The weasels, B. H. WARREN (*Pennsylvania Sta. Rpt. 1893, pp. 159–168, pls. 2*).—Descriptive notes on *Putorius erminea* and *P. vulgaris*, with notes on their habits. The change of color from brown in summer to white in winter is described at some length, and colored illustrations of each pelage are given. Their food is remarked upon, and their destructiveness to poultry and game especially noted. A table is included giving the condensed reports of 100 observers in regard to the food and habits of weasels.

The destruction of animals injurious to agriculture, J. DANYSZ (*Ann. Sci. Agron., 10 (1893), I, No. 3, pp. 410–491*).—A review of work on the destruction of rodents and insects by means of contagious diseases.

METEOROLOGY.

Winds injurious to vegetation and crops, G. E. CURTIS (*U. S. Dept. Agr., Weather Bureau Bul. 11, pt. 2, Rpt. Internat. Meteorolog. Congress, 1893, pt. 2, pp. 435–444*).—Destructive winds are placed in one of the following classes: (1) Violent winds; (2) cold winds; (3) hot desiccating winds.

In the United States the tornado, the derecho, and the West Indian hurricane are the most violent of the class of winds which destroy by their force alone, but as they occur only over limited areas, or at very long intervals, their aggregate damage to fruits and crops is much less than is caused by the winds which frequently accompany local thunderstorms, and by the severe gales which often prevail during the passage of intense general storms.

The region of greatest destruction by violent winds in the United States is the Great Plains region, from Illinois westward to the boundary of cultivation. The greatest destruction is effected when such winds prevail at a late stage of the ripening grain, when the heads are thrashed out by the beating winds.

There are two classes of injurious cold winds: (1) Mountain and valley winds; (2) anticyclonic winds, or northerly winds associated with and following cyclones. In the United States mountain and valley winds do not occur to any marked extent, but in part of Europe these winds are exceedingly injurious to the vine and other tender fruits. The second class of cold winds includes those called blizzards and northers in the United States, and the mistral and bora of southern Europe. The fruit orchard is the principal victim of these piercing blasts. These cold winds are the principal enemy of the tender peach

and determine the limit of its successful cultivation. A remarkable example of their effect is to be found in the climatic history of Michigan, where a half century ago peach trees flourished and were rarely injured by the cold; but after the lumberman began his work of deforestation Dakota blizzards made greater and greater inroads into the State, the tender peach trees were killed along their path, and now the peach crop has nearly disappeared. From the same cause the attempt to grow peaches in northern Kansas has been largely abandoned.

The third class of winds injurious to agriculture are those characterized by intense heat and dryness.

The hot winds of the Plains occur over a vast agricultural area and in some seasons do incalculable damage to all crops, and especially to wheat and corn, which cover the greatest acreage. The area over which they prevail extends from Dakota to Texas; in occasional seasons they occur east of the ninety-fifth meridian, but their greatest frequency and severity is westward of that meridian to the boundaries of cultivation. An illustration of their destructiveness to agriculture may be drawn from the statistics of 10 Kansas counties in 1888, which showed a loss of 21,000,000 bu. of corn alone, due principally to hot winds.

Some of the results of an investigation of the hot winds of 1889 are here given: They are usually from the southwest, and occur most frequently in July and August. They generally continue for about three days. The typical hot wind sets in at 9 or 10 a. m. and continues until about 5 p. m. In 6 hot winds reported the temperature ranged from 100 to 109° F. The average humidity probably did not exceed 25 per cent. The force of the wind varied from a "moderate breeze" to a "strong wind;" in one case it ranged from a "high wind" to a "gale." No quantitative measures of the rate of evaporation were received, but the rate was doubtless very high.

In general hot winds do not materially affect the crops until by their evaporative effect they have drained the soil of its moisture. All circumstances that conduce to diminish evaporation are most potent factors in preserving a crop of corn or wheat through a trying period. Freedom from weeds, deep plowing, and frequent cultivation which breaks up the capillary ducts in the soil, a sandy rather than a clayey surface soil, a subsoil of hardpan which stores up the rain waters for the crops to draw upon in critical periods—these are some of the conditions which diminish the rate of evaporation and delay the beginning of the drought.

Similar in effect to the hot winds of the Plains are those of the Pacific Coast. These occur in the Sacramento and San Joaquin valleys of California and to some extent in portions of Oregon and Washington. In California these winds are northerly, and are often designated as the "desiccating north wind." The greatest injury is done when the north wind occurs in May and June, during the periods when the great

California wheat crop may receive incalculable damage. In Oregon, as in California, the hot winds are especially injurious in June. Mr. B. S. Pague, of the National and the Oregon Weather Service, states:

"Three days of hot winds may reduce yields from 30 bu. per acre to wheat not fit even for hay. The character of the wind is abnormal dryness, varying in force from 6 to 15 miles per hour, and accompanied by temperatures of from 75 to 90° F. The dry wind continues during the night, abating some, while the temperature has its diurnal change."

The California fruit grower has been among the earliest to recognize the efficacy of timber belts as a protection against the damaging effect of wind, and around many of the citrus groves of southern California may now be seen rows of eucalyptus or other trees for wind protection.

The great western plains offer the greatest sphere for the operation of timber as wind-breaks, for this is the natural home of all the destructive winds.

Many attempts at tree planting on the western plains have met with poor success because they have been improperly conducted. The aridity of the climate requires that suitable varieties be selected and properly combined; that a sufficient mass of foliage be obtained to create favorable conditions of growth, and then that the trees should not be left to themselves, but should be as thoroughly cultivated as any crop of grain. Sufficient experience has now been attained to demonstrate that, when these conditions are observed, timber strips can be successfully grown in Kansas as far west as the one hundred and first meridian, or beyond the present boundaries of successful agriculture. The last report from the experimental station at Garden City, in western Kansas, states that the timber strips planted for wind-breaks have made a marvelous growth. These strips consist of four rows of black locusts bordering all sides of a 160-acre lot, and several rows of cottonwoods on one side of an 80-acre lot.

The protective effect of standing timber as an obstruction to the wind being recognized, it is important to know to what distance this protection is extended. The extent of the protective action of a vertical obstruction is accurately exemplified by the distance to which a snow bank extends on the leeward side of a fence. This is the width of the protected strip and we desire to know its ratio to the height of the obstruction. Mr. Barnard, of Pawnee County, Nebraska, and Judge Whiting, of Iowa, are authorities for stating that the protection amounts to 1 rod (16½ feet) on the ground to every foot in height of the protecting trees. Other writers give a somewhat less ratio for the distance of protection, but an average estimate is that a solid belt of trees creates a calm area on its leeward side which is, at the ground, from 11 to 16 times as wide as the height of the trees.

Observation also indicates that barriers and obstructions, like buildings and trees, diminished the general velocity of the surface wind beyond the limits of their immediate protective influence. These data,

therefore, lead us to believe that if timber strips are planted at distances apart not greater than a half mile, or in other terms, if every 160-acre lot is surrounded by a belt of trees like that at Garden City, a very considerable protection will be afforded to the entire acreage.

If the plains of Kansas were cross-sectioned by such timber belts, platting the State into 160-acre lots, the blizzards and the hot winds that now possess an unobstructed passage would be stayed in their course, their blighting and desiccating effects would be largely diminished, and thereby a long step would be taken toward that climatic amelioration which alone is wanting to make a large part of the prairie a veritable garden spot.—O. L. FASSIG.

Variations in the character of the seasons, H. GAWTHROP (*Amer. Met. Jour., 11 (1895), No. 9, pp. 332–339*).—The author presents figures showing the course of temperature at Philadelphia from October, 1888, to October, 1893, which period he divides up into 44 courses averaging 42½ days each. As a substitute for his plan of averaging daily means in 30-day periods the courses which he now adopts are not restricted to any definite number of days; in fact, the longest of the 44 comprises 191 days, viz, from January 2, to July 12, 1890. After some very general remarks he concludes—

"The primal cause for the variations in the character of our seasons must be traced back through all the effects of diurnal and seasonal insolation, and of the cyclonic storms in the lower atmosphere, where it is manifested to us, up to the ever-flowing westerly current above. . . .

"The vast movement from west to east of the upper atmosphere in our middle latitudes, extending to a width of 2,000 miles and more, I would liken to a river with its swift current in the middle, gradually lessening in velocity at the sides and bottom, though there is one movement different from any river, and that is the oscillations north and south with the sun. . . . Like a river, however, it must have a persistence in its flow, because of the inertia of its great volume, and yet again, like a river, this inertia may be overcome, and the direction changed by obstacles or influences in its bed. A straight ditch through a meadow becomes a crooked creek, by reason of the inequalities the water meets in its flow, and the river in greater volume swings in longer stretches from bend to bend. This, then, is my thought, that the great atmospheric river changes its course, southing at one time and northing at another, because of the influences it meets in passing over the surface of the earth."

Among the influences disturbing this upper current he enumerates the two great continents and the two great oceans of the world, the annual movement of the sun northward and southward, and the tropical cyclones. He concludes by an appeal for the exploration of the upper atmosphere.

[The exploration of the upper atmosphere is undoubtedly an important desideratum, but it may well be doubted whether there is a uniform westerly current at great altitudes doing the work that is imagined by Mr. Gawthrop.]—C. ABBE.

Rhythm in the weather, H. H. CLAYTON (*Amer. Met. Jour., 11 (1895), No. 10, pp. 376–380*).—"To most persons nothing seems more irregular and fitful than the weather. Yet I think there is good reason

to believe that through all this seeming irregularity there runs a web of harmony and rhythm.

"The yearly and daily weather periods are well known, but these, I believe, are not the only regular periods to be found. A year ago I described two rhythmic periods in the weather, one of about $7\frac{1}{4}$ and the other of about $6\frac{1}{5}$ days in length. To these I will now add two shorter periods, one of 5 days 10.8 hours, and the other of about 4 days 15 hours. The action of these on the atmosphere is usually in combination, but they independently vary in intensity, so that now one and now the other predominates and gives its especial characteristics to the weather changes."

Investigations of these periods in all parts of the world indicate unmistakably that they exist in every part both of the northern and southern hemispheres.

Observations on dates of maximum temperatures during May and June, 1894, are reported which show a close agreement of the observed dates with those indicated by the $5\frac{1}{2}$ and $7\frac{1}{4}$ day periods.

"During the summer I computed a series of normal waves for each of the periods, and by taking the times of maxima and minima and the amplitude from observation, I found it possible to reproduce the observed temperature with great accuracy, and even to plot a curve for a week in advance which would represent the observed temperature or pressure very closely as long as the periods continued to run without a break. . . . The predicted and observed temperature followed almost exactly the same course; but what is most remarkable is the fact that the predicted minimum temperature and the observed minimum temperature was the lowest observed in August for more than 9 years.

"After I had made some progress in the investigation of these weather periods, an experiment was begun to ascertain how far they could be made useful in forecasting. Beginning with January 27, forecasts were published each week in a local newspaper. These forecasts consisted in stating which days were likely to be warmest and coldest, and on which rain or snow was most likely to fall. After 2 months these were verified, and it was found that of 17 days, mentioned as days on which rain was probable, rain fell on 12; while on the average for each 17 days not mentioned, rain fell on 5, indicating that the percentage of rain was twice as great on days when rain was forecasted as on other days. Two days were named each week as likely to be the warmest days. In 6 weeks out of 8 the warmest day of the week occurred on one of these. The coldest days were predicted in a similar manner, and in 4 cases out of 8 the coldest day of the week occurred on one of the days predicted. Since 2 days were included in each week, the chances were that 2 out of every 7, or 28 per cent might prove accidentally correct, while in reality 75 per cent of the warmest days were correctly predicted, and 50 per cent of the coldest.

"These facts appeared to indicate that the forecasts might prove of benefit to farmers and others, and accordingly on June 2 the issue of a weekly bulletin for general distribution was begun. These bulletins met with an encouraging support, and it was decided to continue them through the year. At the end of September, a verification of the forecasts was made, and it was found that out of 20 warm intervals predicted 13 averaged warmer than the mean of the week, and out of 19 cool intervals predicted 12 averaged cooler than the mean of the week, or about two-thirds in each case. A measurable quantity of rain fell on 33 per cent of the days on which rain was predicted, and on 20 per cent of the days on which no rain was predicted. Reports sent me from various stations indicate that this held substantially true for all of southern New England. The forecasts were made on Friday, and the success for the 5 days from Monday to Friday was about the same as for the other days.

"The excess in favor of the forecasts is not so great as I had at first hoped, but shows, as fully as it is possible to do, that the forecasts have a scientific basis, and are not merely the result of guesswork."

The difficulties which have been found to impair the accuracy of forecasting by this method are interference of the weather waves, by which one series is destroyed or its phase reversed, and two sets of storms, during October, one coming over New England from the lakes, the other from the South.

"The results were too intricate for my analysis, and produced a series of disheartening failures in the forecasts.

"Difficulties are to be expected in a new enterprise, but I am confident that they will be solved, one by one, until an exact science of the weather is constructed." The measure of success already attained is held to be "substantial evidence that the right clue to long-range weather forecasting has been found and will some day be perfected."

The moon and rainfall, H. A. HAZEN (*Amer. Met. Jour.*, *11* (*1895*), *No. 10*, *pp. 373–375*).—Investigations made by the author at New Haven in 1880 showed "that nearly one-half more precipitation occurred at the time of new than of full moon." A study of the records for one hundred years at London yielded negative results, as did that of the rainfall of the whole country. The latter indicated "that the influence, if there were one, must be looked for in a rather circumscribed region."

The present paper records a study of the rainfall of New York City, New Haven, Connecticut, and Boston, Massachusetts, arranged according to each lunation, 296 lunations in 3 groups being represented.

"While both New York and New Haven show an increase at the time of new moon, yet the figures at Boston show a very remarkable maximum at the day of new moon, and an equally remarkable minimum on the seventeenth day of the lunation, or two days after full moon. I do not set forth these figures as an absolute proof that the moon does influence rainfall in the neighborhood of Boston, but it looks as though there must be something in it. There are at times remarkable reversals in the curves whereby a minimum point in one curve coincides with a maximum in the next, but to offset these there are remarkable coincidences; for example, a marked maximum at the twentieth day of the lunation throughout. It will require a good many more observations to prove anything one way or the other, but it would seem as though the curve at Boston could not be very materially modified with less than fifty years' observations."

Meteorological observations at Massachusetts Hatch Station, C. D. WARNER and F. L. WARREN (*Massachusetts Hatch Sta. Met. Bul. 72, pp. 5*).—Daily and monthly summaries of observations during December, 1894, and a general summary for the year. The annual summary is as follows: *Pressure* (inches).—Actual maximum, 30.47, January 17, 10 p. m.; actual minimum, 28.59, January 30, 6 a. m.; mean reduced to sea level, 30.085; annual range, 1.88. *Temperature*[1] (degrees F.).—Maximum, 97, 98, July 20; minimum, —9, —17, February 25; mean, 49.7, 47.9; annual range, 106, 115; maximum mean daily, 82.5, 84, July

[1] The first figures denote reading at top of tower (51 ft. above the ground), the second at base.

28; minimum mean daily, 1, —1.5, February 24; mean maximum, 57.7, 59.6; mean minimum, 38, 36.9; mean daily range, 16.5, 22.7; maximum daily range, 35, May 12, 47.5, February 17; minimum daily range, 2, 5, October 25. *Humidity.*—Mean dew point, 40.5; mean force of vapor, 0.4416; mean relative humidity, 71.9. *Precipitation.*—Total rainfall or melted snow, 32.64 in.; number of days on which 0.01 in. of rain or melted snow fell, 125; total snowfall, 71½ in. *Weather.*—Mean cloudiness observed, 50.5 per cent; total cloudiness recorded by the sun thermometer, 2,488 hours, or 54.9 per cent; number of clear days, 107; number of fair days, 83; number of cloudy days, 175. *Wind.*—Direction, SW., 17 per cent; S., 15 per cent; N., 15 per cent; NW., 13 per cent; total movement, 36,257 miles; maximum daily movement, 443 miles, April 13; minimum daily movement, 0 miles, September 29; mean daily movement, 99.4; mean hourly velocity, 4.1 miles; maximum pressure per square foot, 22½ lbs. = 67 miles per hour, February 23, 2 p. m. *Bright sunshine.*—Number of hours recorded, 2,051. *Mean ozone*, 24.9 per cent. *Dates of frost.*—Last, May 22; first, August 22. *Dates of snow.*—Last, April 12; first, November 5.

Meteorological observations at Pennsylvania Station, W. FREAR and W. S. SWEETSER (*Pennsylvania Sta. Rpt. 1893, pp. 169–173, 182–188, 193–222*).—The meteorological work of the station in 1893 was "chiefly a continuation of the work of the preceding years, including observations of the kind usually made by the United States Weather Service upon atmospheric phenomena, and also observations upon soil temperatures at various depths and upon the amount of sunshine" (E. S. R., 6, p. 115). Monthly summaries of observations and weekly crop reports are given in the body of the report and the detailed daily record in an appendix. The annual summary is as follows:

Summary of meteorological observations, 1893.

	Year 1893.	Growing season (Apr. to Sept., 1893).
Barometer (inches):		
Mean	29.905	
Highest	30.857 (Feb. 5)	
Lowest	29.113 (Oct. 14)	
Temperature (°F.):		
Mean	47.6	62.
Highest	92 (June 20, Aug. 11)	92 (June 20, Aug. 11).
Lowest	—7 (Jan. 18)	29 (Apr. 11).
Annual range	99	21.1.
Mean daily range	19.1	43 (Aug. 5, Sept. 5).
Greatest daily range	43 (Aug. 5, Sept. 5)	
Least daily range	3 (Jan. 28, Mar. 23)	
Mean daily relative humidity (per cent)	78.2	72.95.
Rainfall (inches):		
Total	42.2	24.99.
Greatest monthly	64.6 (May)	
Greatest daily	1.6 (Aug. 29)	1.60 (Aug. 29).
Number of days on which 0.01 in. or more of rain fell	135	69.
Mean percentage of cloudiness	60.95	55.8.
Number of days on which cloudiness averaged 80 per cent or more	152	66.
Average hours of sunshine per day		5 h. 56 min.
Wind (miles):		
Total movement	32,700	
Maximum velocity	40 (Feb. 19)	
Greatest daily movement	425 (May 4)	
Last frost in spring		May 8.
First frost in fall		Sept. 27.

Principal periods of crop development.

Wheat:
- Sown September 5–12, 1892.
- In bloom June 9, 1893.
- Ripening June 23.
- Harvested July 14–21.

Corn:
- Planted May 19.
- In silk August 4.
- Cut September 8 to October 6.
- Husking began October 6.

Oats:
- Sown April 24.
- Ripening July 28.
- Harvested August 4.

Potatoes:
- Planted May 19.
- Harvested (late varieties) September 8 to 29.

Grass:
- In bloom June 23.
- Hay cut June 30 to July 14.

Clover:
- Cut June 23.
- Second crop in bloom August 4.

"The weather in general pleasant, but marked departure from the average. For the year as a whole, the minimum temperature was somewhat below the usual figure, and the mean daily range a trifle high. The total rainfall was somewhat above the average, as was the cloudiness. For the winter season of 1892–'93 the mean temperature was low; while the snowfall was heavy, especially in February, the winter was dry and cisterns were emptied. During the growing season of 1893 the mean daily range of atmospheric temperature was a trifle above the average, but that of the soil further below the average. The rainfall was not excessive, and was fairly distributed; coming at haying and at spring plowing time, it retarded farm operations, while there was some drought in midsummer. In general, the year was cloudy. The hay crop was moderate, wheat good, oats a little light, and corn considerably below the average, it having suffered from summer drought. In spite of late planting, it matured fully as early as usual."

The distribution of storms on the surface of the globe (*Rev. Scientif., 10 (1895), No. 3, pp. 92, 93*).

The cause of the cyclones of the temperate latitudes, W. H. DINES (*Amer. Met. Jour., 11 (1895), No. 10, pp. 359–364*).—A discussion of Ferrel's convection theory and Hann's eddy theory, the weight of evidence being stated to be in favor of the former.

Recent foreign studies of thunderstorms, R. DEC. WARD (*Amer. Met. Jour., 11 (1895), No. 10, pp. 364–368*).—A brief review of recent reports of investigations of this subject in Russia.

Psychrometer studies, H. A. HAZEN (*Amer. Met. Jour., 11 (1895), No. 10, pp. 371–373*).—A criticism of Ekholm's methods and results in this line.

Gulf storm notes, W. D. STEARNS (*Amer. Met. Jour., 11 (1895), No. 10, pp. 368–371*).—Notes taken during the passage of the Gulf storm of October 4 to 11, 1894.

Meteorological summary for North Carolina for November, 1894, H. B. BATTLE, C. F. VON HERRMANN, and R. NUNN (*North Carolina Sta. Weather Service Bul. 62, pp. 171–183, charts 2*).—The usual summaries of observations by the State Weather Service coöperating with the Weather Bureau of this Department.

Mexican meteorological bibliography, R. AGUILAR Y SANTILLÁN (*Mem. Rev. Soc. Cient. "Antonio Alzate," 8 (1894–'95), No. 1 and 2, pp. 5–9*).—This is for the year 1893, uniform with similar bibliographies for preceding years by the same author, published in previous volumes of this journal.

Observations on dew and frost, R. RUSSELL (*Naturwiss. Rundschau, 1893, No. 19, pp. 235–239; abs. in Centbl. agr. Chem., 23 (1894), No. 10, p. 697*).—The author reports independent observations which confirm the conclusions of a number of other investigators that dew and frost are largely produced by the aqueous vapor arising from the earth, and that the aqueous exhalations of plants also contribute to dew formation.

SOILS.

On the movement of water in the soil, MOORMANN (*Schilling's Jour. für Gasbeleuchtung und Wasserversorgung, 1894; abs. in Forsch. Geb. agr. Phys., 17 (1894), No. 5, pp. 449, 450*).—The principal point brought out in this paper is that in all soils water forms hydrates (termed by Graham and Mendelejeff hydrosols) which more or less completely fill up the soil pores and interfere with the circulation of water.

The fact that wet sand molded by the hand retains its shape after drying is an evidence that the water has developed a binding power which the sand did not previously possess. This can be explained in case of pure sand, it is claimed, only by the formation of a thin coating of hydrate of silica which binds the particles together. The finer the sand the greater the amount of this hydrate formed.

While this formation of hydrates in sand lessens the friction between particles and causes them to occupy less space, in case of close-grained dry clay it is so great that the clay increases in volume almost 15 per cent in absorbing the ordinary amount of soil moisture.

In support of the theory that water combines chemically with clay soils it is pointed out that moderately moist clay yields no water on pressure, and that moistening of clay generates an appreciable amount of heat and develops a peculiar odor, at the same time evolving gases. The influence that this formation of hydrates has on the circulation of the water of the soil depends, of course, upon the fineness of the soil particles and the amount of hydrates formed.

Soil temperatures, W. FREAR and W. S. SWEETSER (*Pennsylvania Sta. Rpt. 1893, pp. 174–181, 187, 223–246*).—A record is given of tri-daily observations during 1893 with thermometers at the surface and at depths of from 1 to 24 in.

The following is a summary of observations during the growing season:

Soil temperatures, April to September, 1893.

Depth.	Highest.	Lowest.	Daily mean.	Mean daily range.	Greatest daily range.
	Deg. F.	*Deg. F.*	*Deg. F.*	*Deg. F.*	*Deg. F.*
At surface	81.0 (June 20, July 4, Aug. 11).	33.0 (Apr. 2)	61.3	8.99	24.0 (Apr. 3, 8).
1 in. deep	81.0 (Aug. 11)	32.0 (Apr. 2)	60.4	8.44	23.5 (Apr. 8).
3 in. deep	76.5 (Aug. 11)	32.0 (Apr. 2, 3)	60.9	4.27	17.0 (May 30).
6 in. deep	76.0 (Aug. 11)	32.0 (Apr. 1, 2, 3)	60.1	2.86	9.5 (Apr. 8).
12 in. deep	73.0 (Aug. 11)	32.5 (Apr. 1, 5)	60.0	1.13	4.5 (Apr. 8).
24 in. deep	69.5 (Aug. 28, 29)	33.0 (Apr. 1-4)	58.5	0.25	1.5 (May 8, Sept. 12).

Analyses of soils, H. SNYDER (*Minnesota Sta. Rpt. 1893, pp. 254–258*).—Analyses of 17 samples in addition to those reported in Bulletin 30 of the station (E. S. R., 5, p. 857) are tabulated and briefly discussed.

"Most of these soils have been under cultivation from 5 to 30 years.

"The first impression of the results would indicate that the weak point is in the potash content. . . . In many of these soils the total potash amounts to as much as 2.5 per cent, while the amount of potash soluble in acid amounts to only a little over 0.20 per cent. There is every indication . . . that much of the potash that is insoluble in the acid possesses agricultural value. . . .

"These analyses, as well as those reported in former publications, show that most of the typical soils of the State are well supplied with phosphoric acid. . . .

"There is a good content of lime in most of the typical soils of the State."

The action of organic and mineral acids upon soils, H. SNYDER (*Jour. Amer. Chem. Soc., 17 (1895), No. 2, pp. 148–151*).—Comparative tests of the solvent action of hydrochloric acid of 1.115 sp. gr.; 10 per cent solutions of citric, oxalic, and tartaric acids; and a 10 per cent mixture of the last three, were made on the same sample of soil. The digestion was carried on for 36 hours in the Snyder soil flask (see p. 689). The results obtained were as follows:

Solvent action of hydrochloric and organic acids upon soil.

	Hydrochloric acid 1.115 sp. gr.	Ten per cent solution of—			
		Citric acid.	Oxalic acid.	Tartaric acid	Organic acid mixture.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Total insoluble matter	84.08	87.90	85.07	87.67	85.93
Potash	0.30	0.12	0.18	0.06	0.10
Soda	0.25	0.17	0.19	0.05	0.12
Lime	0.51	0.50	0.23	0.41	0.45
Magnesia	0.26	0.27	0.21	0.32	0.33
Iron oxid	2.56	1.59	1.14	1.62	2.23
Alumina	4.24	1.45	3.96	1.77	2.99
Phosphoric anhydrid	0.23	0.26	0.14	0.11	0.26
Sulphuric anhydrid	0.08	0.10	0.05	0.06	0.05

"The oxalic acid possesses the greatest solvent action upon the complex insoluble matter of an alkaline nature. The citric acid possesses the greatest solvent action upon the lime, magnesia, and the sulphuric and phosphoric anhydrids. The amount of lime dissolved by the oxalic acid is greater than would at first be expected, but the complex nature of the solution and the presence of the salts of other metals has caused nearly half as much lime to be dissolved by the oxalic acid as by the hydrochloric acid of 1.115 sp. gr.

"The 10 per cent mixture of the 3 organic acids has resulted in dissolving as much phosphates and magnesia and nearly as much lime as any one of the acids acting alone. The potash does not appear to be as soluble in the organic acid mixture as the other elements of plant food.

"The amount of potassium, iron, and aluminum oxids dissolved by these 3 organic acids and their mixtures is somewhat less than that dissolved by the hydrochloric acid. . . . The main difference between the solvent action of the hydrochloric and the organic acids is in the somewhat smaller amount of potash dissolved by the organic acids.

"With the exception of the solubility of the potash, as noted, these results bring out in a general manner the value of hydrochloric acid of 1.115 sp. gr. as a solvent over the organic acids of 10 per cent strength, because the hydrochloric acid represents the limit of the solvent action reached by any one of the organic acids acting alone or in a mixture."

The solvent action of concentrated mineral acids, hydrochloric, nitric, and sulphuric, was tested on the same sample of soil and compared with the results obtained by the fusion method.

"Concentrated hydrochloric acid, 40 per cent strength, dissolved 2¼ per cent more of the complex silicates than nitric acid of the same strength. Concentrated nitric acid possesses a stronger solvent action than the dilute hydrochloric acid. The concentrated hydrochloric acid dissolved somewhat more potash than the hydrochloric acid of 1.115 sp. gr. The amount of lime, phosphates, and sulphates dissolved by the concentrated hydrochloric acid was about the same as when the more dilute acid was used; the concentrated acid, however, dissolved more of the complex silicates of potash, iron, and alumina. Sulphuric acid possesses the strongest solvent action.

"Of the total potash in the soil as determined by fusion, less than 18 per cent is soluble in the hydrochloric acid as used in soil analysis; about 10 per cent is soluble in oxalic acid, and 3 per cent in tartaric acid."

The chemical analysis of the soil in its relation to fertilizer experiments, VON LIEBENBERG and E. VON PROSKOWETZ, Jr. (*Mitt. Ver. Förd. landw. Versuchw. Oesterr., 1894, No. 9, pt. 1, pp. 23–35*).—As in the two previous years (E. S. R., 5, p. 702), the soil of plats containing 100 square meters on which fertilizer experiments on barley and oats were made was carefully sampled and analyzed and the results of analysis compared with the action of the fertilizers employed. In previous analyses only the phosphoric acid and nitrogen were determined, while in the present case potash soluble in nitric acid was also estimated. The results in general confirm those of previous investigations. Nitrogen was found to be as a rule more abundant in the soil than in the subsoil. The relation of phosphoric acid in the soil and subsoil was variable, being influenced evidently by the previous system of culture and manuring. The same was true in general of the potash. In the heavy soils used the potash was in almost every case considerably higher than the phosphoric acid and frequently higher than the lime. The soils are therefore much benefited by calcareous manures.

The experiments with barley indicated that in unfertilized soil the yield varied directly with the amount of nitrogen present. As in previous years, the yield was greater the greater the proportion of nitrogen to phosphoric acid, provided a sufficient amount of phosphoric acid and potash was present. The ratio of phosphoric acid to nitrogen in the first series of soils was 1 to 1.38, in the second series 1 to 1.06. In almost every case the soils responded to applications of nitrate of soda, although the soils contained amounts of nitrogen varying from 17 to 84 kg. per 100 square meters of soil.

With phosphatic fertilizers the results were irregular, but as a rule they were effective on barley on soils containing an average of 24.5 kg. of phosphoric acid in 100 square meters of the surface soil, and on oats on soils containing an average of 23.4 kg. It is concluded that on soils containing more than about 40 kg. of phosphoric acid per 100 square meters of surface soil manuring with phosphates is of doubtful value or

entirely useless for cereals, unless accompanied by heavy applications of nitrogenous fertilizers. This limit of profitable application of phosphatic manures will be exceeded or fallen short of according to the availability of the phosphoric acid of the soil, the season, etc.

The season was such and the number of experiments with potash so small that no definite conclusions as to the limit of profitable potash fertilizing can be drawn, but it is shown with considerable certainty that the limit is considerably higher than with phosphatic manures. It appears also that for cereals soils must contain more lime than potash in order that potash fertilizing may be profitable.

Conservation of moisture in the soil, S. B. GREEN (*Minnesota Sta. Rpt. 1893, pp. 232–238*).—Reprinted from Bulletin 32 of the station (E. S. R., 6, p. 21).

Nitrification, J. R. HARRIS (*Jour. Elisha Mitchell Sci. Soc., 11 (1894), No. 1, pp. 16–25*).—A résumé.

The conservation of nitrates in the soil (*Jour. Agr. Prat., 59 (1895), No. 4, pp. 144, 145*).—A brief summary of Dehérain's results.

The available plant food in soils (*Jour. Bath and West of England Soc., 4 (1893–'94), ser. 4, pp. 212–215*).—A brief review of an article by B. Dyer on this subject.[1]

The composition of native and cultivated soils and the effects of continuous cultivation upon their fertility, H. SNYDER (*Minnesota Sta. Rpt. 1893, pp. 163–191*).—A reprint of Bulletin 30 of the station (E. S. R., 5, p. 857), with the addition of brief notes on the collecting and forwarding of soil samples.

The management of clay farms, W. F. BROWN (*Cult. and Country Gent., 70 (1895), No. 2195, pp. 143, 144*).—Notes on cultivation on clay land in Ohio, with advice as to its proper treatment.

FERTILIZERS.

Analyses and valuation of complete fertilizers, ground bone, and miscellaneous samples, E. B. VOORHEES, L. A. VOORHEES, and J. P. STREET (*New Jersey Stas. Bul. 104, pp. 46*).—This is the second of the two regular annual bulletins on fertilizers issued by the station. The main object of the first (Bul. 102; E. S. R., 6, p. 396) was "to show the sources and composition of the materials containing the best forms of nitrogen, phosphoric acid, and potash; the cost per pound of the ingredients; and the advantages of making home mixtures." The present bulletin gives analyses and valuation of 224 samples of mixed fertilizers, 29 samples of bone, 9 samples of wood ashes, and 17 samples of miscellaneous products, the main object being "to show whether the actual composition of the various products corresponds with their guaranty as required by law."

As a rule the fertilizers examined contained as much total plant food as was guaranteed, but in many cases "it was not distributed in the proportions stated in the guaranties, which indicate either a lack of skill or of carefulness in their preparation. In two cases only the consumer received less of all of the plant-food constituents than was guaranteed."

[1] Jour. Chem. Soc. London, 1894, Mar., p. 115 (E. S. R., 5, p. 1013).

"Ninety-six of the 224 brands, or 43 per cent, contained less phosphoric acid than was guaranteed; 27 brands contained less potash, and 20 less nitrogen. In the case of nitrogen particularly, the actual amount contained was in many cases greatly in excess of the guaranty.

"The chief difficulty in respect to keeping the guaranty was in the case of phosphoric acid.

"The average composition, selling price, and commercial valuation per ton of all the brands of mixed fertilizers examined in 1891, 1892, 1893, and 1894, as well as the percentage difference between valuation and selling price, or the charges for mixing, bagging, and selling, are shown in the following tabulation:

Average composition, selling price, and valuation of fertilizers.

	Total nitrogen.	Total phos. acid.	Available phos. acid.	Insoluble phos. acid.	Potash.	Selling price.	Station valuation.	Percentage difference.
1891	2.71	10.12	7.29	2.83	4.21	$34.23	$25.31	35.2
1892	2.74	10.38	7.70	2.67	4.50	34.19	25.66	33.2
1893	2.69	10.23	7.54	2.69	4.58	34.11	24.41	39.7
1894	2.87	10.40	7.37	3.03	4.94	34.17	24.83	37.6

"At the average cost per pound of the nitrogen, phosphoric acid, and potash in these fertilizers it would cost the farmer 36 cts. to return to the soil the fertilizing ingredients carried off in every bushel of wheat sold, 28 cts. to return the amount contained in a bushel of corn, 30 cts. to return that contained in a bushel of rye, 18 cts. for that contained in a bushel of oats, and $7.16 to return the fertilizer constituents removed in a ton of timothy hay. . . .

"It is clear that at these prices for plant food a very narrow margin is left to the farmer in the sale of crops for legitimate charges for labor of growing, hauling, selling, and other expenses."

Still it is maintained that the use of fertilizers is profitable, even under these conditions. It is recommended, however, to (1) reduce cost of plant food in mixed fertilizers by buying on the "unit"[1] basis; (2) limit exportation of fertilizing constituents from farms on which stock is kept "by a judicious exchange of grain and hay for concentrated feeds rich in the fertilizing constituents, coupled with careful saving and intelligent application of the manure made;" and (3) reduce the outlay for the expensive element nitrogen "by sowing larger areas of leguminous crops which gather nitrogen from the air." Crimson clover is considered especially valuable for this purpose.

"The samples of ground bone examined this year, on the whole, reached their guaranty, showed a good degree of fineness, and, with few exceptions, a relatively high valuation. A larger number than usual, however, belonged to the class 'steamed bone.' . . .

"The number of samples of wood ashes examined this year was somewhat larger than usual, and they showed the usual wide variation in composition. . . . With but one or two exceptions the prices charged for the plant-food constituents were excessive."

Fertilizing with phosphoric acid as a means of producing cheap nitrogen, P. WAGNER (*Deut. landw. Presse, 22 (1895), No. 1, pp. 5, 6, figs. 3*).—Pot experiments with fertilizers on oats, peas, and vetches are

[1] One per cent per ton or 20 lbs.

reported, illustrating especially the difference in the relation of leguminous plants and cereals toward nitrogen. It appears from these experiments that potash and phosphoric acid were without effect on oats except when used in connection with nitrogen. On the other hand, they exerted their full effect on the peas and vetches without the addition of nitrogen. The yields on the pots under different methods of fertilizing were as follows:

Yields of oats, peas, and vetches with different fertilizers.

	Without nitrogen.			With nitrogen.		
	Oats.	Peas.	Vetches.	Oats.	Peas.	Vetches.
	Grams.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
With potash and phosphoric acid	29	317	287	415	376	332
Without potash and phosphoric acid	32	131	85	126	159	126
Increase due to potash and phosphoric acid	—3	186	202	289	217	206

The oats grown on the unfertilized soil and on the soil fertilized only with potash and phosphoric acid contained on the average 0.23 gm. of nitrogen per pot; while the peas grown on the unfertilized pot contained 2.02 gm. of nitrogen, and on the pot fertilized with potash and phosphoric acid 6.11 gm. of nitrogen. The results plainly show that potash and phosphoric acid were without effect on cereals except when a supply of soluble nitrogen was present in the soil or was furnished in the fertilizer, but that they were effective on leguminous plants when the nitrogen was deficient, because these plants assimilate the nitrogen of the air.

From these experiments it appears that for each 100 kg. of phosphoric acid which the soil or the fertilizer furnishes to vetches 400 kg. of atmospheric nitrogen is collected and stored up in the plant tissue; while for each 100 kg. of phosphoric acid furnished to oats 250 kg. of nitrogen is drawn from the soil or the fertilizer applied.

In order that leguminous plants may collect the maximum amount of nitrogen from the air they must be liberally fertilized with phosphoric acid (and, where necessary, with potash). This should be applied when the stubble is turned down and the leguminous crop seeded, or if the latter is seeded among the grain sufficient phospate should be applied to supply the needs of both crops. In no case should the leguminous crop be allowed to hunger for phosphoric acid. The quicker its needs in this respect are supplied the sooner and more rapidly it will collect nitrogen from the air.

The results of investigations of the cause of failures of alfalfa in certain fields of Laubenheim, on the Rhine, are cited as indicating that decline in thriftiness of leguminous plants on soils on which they have been grown continuously for several years may be due to exhaustion of the soil in available phosphoric acid.

Investigations on the foraging powers of some agricultural plants for phosphoric acid, W. BALENTINE (*Maine Sta. Rpt. 1893, pp. 13–25, pls. 21*).—The comparative capacity of wheat, barley, corn, beans, peas, potatoes, and turnips to utilize the phosphoric acid of insoluble phosphates (South Carolina rock) was tested as follows: For each kind of plant 9 wooden boxes 15 in. square and 12 in. deep, containing 120 lbs. of fine sand,[1] were used in 3 sets of 3 boxes each, fertilized as follows: Set I, 8.5 gm. nitrate of soda (1.36 gm. nitrogen), 2.6 gm. muriate of potash (1.36 gm. potash); Set II, 8.5 gm. nitrate of soda (1.36 gm. nitrogen), 2.6 gm. muriate of potash (1.36 gm. potash), 17 gm. South Carolina rock (3.96 gm. insoluble phosphoric acid and 0.39 gm. citrate soluble phosphoric acid); Set III, 8.5 gm. nitrate of soda (1.36 gm. nitrogen), 2.6 gm. muriate of potash (1.36 gm. potash), 28.5 gm. acidulated South Carolina rock (3.34 gm. soluble phosphoric acid, 0.50 citrate soluble phosphoric acid, and 0.62 gm. insoluble phosphoric acid).

The boxes were given proper care, and the crops were harvested at maturity; photographs, from which the plates in the article were made, being taken just before harvesting. The yields obtained were as follows:

Yields of dry matter by different crops.

	Yield of dry matter.		
	Set I.—No phosphate.	Set II.—Insoluble phosphate.	Set III.—Soluble phosphate.
	Grams.	*Grams.*	*Grams.*
Wheat	76.9	148.6	296.3
Barley	201.5	294.9	508.1
Corn	39.5	103.3	291.0
Beans	15.7	17.4	69.8
Peas	112.7	196.7	228.6
Potatoes	113.3	114.6	223.6
Turnips	154.4	304.1	270.4

"While it may not be desirable to draw definite conclusions from so small an amount of data as is furnished by the above-described experiments, there are some points which under the conditions of these experiments the results appear to bring out sharply.

"(1) Different crops showed a decided difference in their powers of obtaining phosphoric acid from crude, finely ground South Carolina rock. Wheat, barley, corn, peas, and turnips apparently appropriated the insoluble phosphoric acid from this source with greater or less ease, while beans and potatoes derived no benefit from it.

"(2) The greatest practical advantage derived from the use of finely ground South Carolina rock was with the turnips. With this crop a larger weight of dry matter and also a larger weight of fresh roots was obtained with insoluble phosphoric acid from the finely ground South Carolina rock than with an equal amount of soluble phosphoric acid from acidulated South Carolina rock.

"(3) The indications point to a profitable use of finely ground South Carolina rock as a manure for barley and peas as well as turnips."

[1] Containing 0.096 per cent of potash and 0.012 per cent of phosphoric acid.

It was incidentally observed in these experiments that "the acidulated South Carolina rock apparently depressed the yield of grain with barley while largely increasing the amount of straw; with wheat both grain and straw were largely increased and in about the same proportion." The figures obtained were as follows:

Effect of acid phosphate on proportion of grain and straw of wheat and barley.

	Set I.	Set II.	Set III.
	Grams.	*Grams.*	*Grams.*
Barley (air dry):			
Total crop	215	312	538
Grain	44	61	17
Wheat (air dry):			
Total crop	84	162	325
Grain	26	50	105

A partial chemical analysis (fertilizing constituents) is given of the total crop produced in each set of boxes.

Results of five years' experiments with fertilizers, W. C. STUBBS (*Louisiana Stas. Bul. 31, 2d ser., pp. 1092–1123*).—After an introduction discussing the forms of fertilizers used with a brief review of the latest investigations relating to the nature, care, and use of barnyard manure, and remarks on the value of leguminous plants in rotation, deductions drawn from five years' experiments with fertilizers for staple crops on three typical soils of the State are reported. The fertilizers which at one time or another have entered into these experiments are: *Nitrogenous fertilizers*—Stable and farm manures, composts with and without cotton seed and with and without acid phosphate, cotton seed (raw, crushed, and rolled), cotton seed meal, nitrate of soda, sulphate of ammonia, dried blood, fish scrap, and tankage; *Phosphatic fertilizers*—Dissolved boneblack, acid phosphate, precipitated dissolved bone, precipitated acid phosphate, bone meal, bone ash, floats, and iron slag; *Potassic fertilizers*—Kainit, muriate of potash, sulphate of potash, nitrate of potash, carbonate of potash, and cotton-hull ashes.

The chemical composition of the soils experimented on was as follows:

Composition of Louisiana soils.

	Audubon Park.		Baton Rouge.				Calhoun.	
	Light soil.	Dark soil.	Bluff soil.	Bluff subsoil.	White soil.	White subsoil.	Front field.	Rear field.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Water	13.230	14.460	1.540	0.874	2.3800	3.320	....	....
Sand and insoluble matter	70.100	62.050	90.650	89.790	87.7200	83.000	97.010	95.510
Soluble silica	....	....	0.133	0.043	0.0784	0.097	0.120	0.090
Potash	0.440	0.180	0.100	0.164	0.1200	0.180	0.023	0.029
Soda	0.120	0.750	0.078	0.054	0.0760	0.123	0.029	0.058
Lime	0.790	0.910	0.170	0.163	0.0600	0.120	0.085	0.145
Magnesia	0.810	1.360	0.114	0.160	0.0210	0.085	0.018	0.074
Ferric oxid Alumina	11.280	13.440	4.225	6.510	6.6700	8.880	0.336 0.762	0.529 0.829
Phosphoric acid	0.160	0.150	0.064	0.128	0.1120	0.106	0.037	0.048
Sulphuric acid	0.020	0.030	0.036	0.025	0.0210	0.016	Trace.	Trace.
Organic matter	3.160	6.650	3.150	2.741	2.8200	4.210	1.575	2.225
Nitrogen	0.112	0.085	....	....	....	....	0.025	0.037

The soil at Audubon Park is alluvial, very stiff, and is benefited by thorough drainage. "It is an excellent quality of 'mixed' soil." That at Baton Rouge is a brown loam belonging geologically to the Bluff formation. It is underlaid at varying depths by white chalky-looking clay. It is greatly benefited by drainage, but this is difficult to obtain on account of the conformation of the land. The Calhoun soils vary from yellow sandy clays to pure sand. "They are naturally very poor, but susceptible of rapid improvement and responsive to the smallest application of manures."

Experiments were made to determine the kind, form, and quantity of each of the fertilizing constituents required by sugar cane, corn, oats, and cotton at Audubon Park; cotton, corn, sugar cane, and potatoes at Baton Rouge; and cotton, corn, sugar cane, tobacco, and potatoes at Calhoun. Experiments have also been made to test the comparative merits of broadcast and drill applications and applications at different dates.

The results show "that the crying want of the Calhoun soils is nitrogen; that the soils of Audubon Park, under favorable seasons, will appropriate one to two rations of nitrogen with profit. Baton Rouge soils are responsive to nitrogen only when properly combined with phosphoric acid."

At Calhoun the order of effectiveness of the different forms of nitrogen was compost of cotton seed, stable manure, and phosphate; crushed cotton seed, nitrate of soda, cotton-seed meal, fish scrap, tankage, sulphate of ammonia, rolled cotton seed, and dried blood. At Audubon Park cotton-seed meal proved the most effective form, followed closely by sulphate of ammonia, fish scrap, nitrate of soda, tankage, and dried blood. At Baton Rouge sulphate of ammonia gave the best results, followed closely, however, by the other forms. It is stated in general that there was little preference in any of these forms of nitrogen. Nitrate of soda appeared to be most effective on light sandy soils, sulphate of ammonia on stiff clay lands.

"At Calhoun, upon thin soils, 1 ration (24 lbs.) of nitrogen is nearly the maximum quantity which crops can now appropriate. With improvement, these soils may digest and render available increased quantities. At Baton Rouge, with favorable seasons, 2 rations (48 lbs.) of nitrogen may be assimilated by the crops with profit, though on account of almost annual droughts, it is unwise to apply, as a rule, larger quantities than 1 ration (24 lbs.). Experiments at both of these stations have determined the above. At Audubon Park 2 rations (48 lbs.) can easily be assimilated by sugar cane in a fair season, provided the soil be well drained and cultivated, *i. e.*, in good tilth. Experiments have shown that 3 rations are excessive and always produce a waste. On cotton, corn, and oats less quantities of nitrogen will suffice. Irish potatoes, cabbage, etc., may easily dispose of with profit 72 lbs. (3 rations) of nitrogen per acre."

The experiments with phosphoric acid indicate "that the soils of Audubon Park and Calhoun require only small doses of phosphates mixed with strongly nitrogenous fertilizers to give remunerative returns, while the soils of Baton Rouge can consume goodly quantities with increased crop products." The soluble forms of phosphoric acid were

invariably more profitable than the insoluble. Of the latter, slag meal was most effective, while bone meal in no case gave a profitable return.

"Neither at Calhoun nor Audubon Park have excessive quantities been beneficial. At the former perhaps 24 lbs. soluble phosphoric acid per acre is an abundance for any crop, while 1 ration (36 lbs.) has been found to be ample for the cane crop at the latter station at Baton Rouge. Upon the best character of soils and in favorable seasons 50 lbs. or more to the acre of this ingredient might be profitably applied to certain crops."

"No crop at any of the 3 stations has been benefited by the application of potassic salts."

The results of the experiments with the different methods of application indicated that—

"If the soil be very loamy or clayey and retains fertilizers well, perhaps little or no loss will occur by putting all the manure under the plant at the time of planting. But if the soil be sandy and inclined to 'leach,' fertilizers, particularly nitrogen compounds, should never be applied all at once under fibrous-rooted plants. Mineral fertilizers may be thus applied, since they leach but little, and even complete fertilizers may be thus used under quickly-growing tap-rooted plants. . . .

"Where the soil is open and porous and root development can occur without hindrance, then broadcasting may be done, with chances that the fibrous roots, permeating easily in every direction, may catch most of the applied fertilizers, but in very stiff, compact soils such extensive root development is impossible, and therefore much of the broadcast fertilizer will not be accessible to the roots of the growing crop. As a rule, then, it may be asserted that broadcasting is permissible upon hoed crops in light soils, but wasteful in stiff, heavy soils."

The results of experiments at Calhoun strongly favor 1 application at time of planting under cotton, but "strongly suggest the practice of making at least 3 applications of fertilizers for such plants as corn, cane, etc. At Baton Rouge little or no loss has occurred from 1 application at time of planting. . . . At Audubon Park experiments have been made similar to those discussed above, with 1, 2, and 3 applications, with as yet, no positive evidence against the prevailing custom of 1 application."

As regards the best depth of application "the consensus of results points unmistakably to the depth of 2 to 3 in. as producing the best results, and also shows the advantage of having all the ingredients combined at this depth."

Successful results with a rotation of oats, cowpeas, cotton, corn, and cowpeas are reported, and in conclusion tabulated data are given for experiments with fertilizers on sugar cane at Audubon Park for 1892 and 1893.

Soil tests with fertilizers in Virginia (*Southern Planter, 56 (1895), No. 2, pp. 79-81*).—The Virginia State Board of Agriculture, at its meeting January 8 to 10, 1895, adopted resolutions appropriating a sum not exceeding $1,500 for the purpose of conducting soil tests with fertilizers, not more than $150 of which is to be expended in any one Congressional district. This money is placed under the control of the Commissioner of Agriculture and the members of the State Board of Agriculture from the different districts in which experiments are made. The services of a scientist to aid in selecting and laying out plats, supervising the experiments from time to time, and preparing reports of results are to be secured through the Virginia Agricultural and Mechanical College, or from some other source, provided such services can be procured for a sum not exceeding $500.

The general plan of the experiments is to be that adopted by the convention of directors of experiment stations at Washington, March, 1889.[1] The experiments are to be made "chiefly in those sections of the State where the exhaustion of the soil and the depressed conditions of agriculture indicate their need."

On what kind of soils, to what crops, and in what forms should lime be applied, B. SCHULTZE (*Braunschw. landw. Ztg., 62 (1894), No. 51, pp. 213, 214*).—A popular article in which the draft of different crops on the lime content of the soil, the variation in lime content of different soils, the influence of chemical fertilizers in causing loss of soil lime, the indirect fertilizing action and physical effect of lime, and the comparative merits of marl, gypsum, and burnt lime are discussed.

Development of the natural sources of nitrogen (*Landw. Centbl. Posen, 23 (1895), No. 2, p. 8*).

The utilization of night soil as a fertilizer, J. H. VOGEL (*Deut. landw. Presse, 22 (1895), No. 8, pp. 66, 67*).

The town sewage question in its agricultural relations, R. S. BURN (*Jour. Bath and West of England Soc., 4 (1893-'94), ser. 4, pp. 106-117*).—A general discussion of this subject, critically reviewing present English systems of sewage disposal and urging the advisability of more extended use of city sewage in liquid form on farm lands.

On Kühn's views on the value of barnyard manure nitrogen, P. WAGNER (*Deut. landw. Presse, 22 (1895), No. 8, pp. 62, 63; No. 10, p. 83*).

The rational use of bone meal, M. ULLMANN (*Jour. Soc. Agr. Brabant; L'Engrais, 10 (1895), No. 5, pp. 113, 114*).—A brief popular summary of information as to the soils best adapted to bone meal and the best methods and time of application.

A new potash deposit (*Landw. Centbl. Posen, 23 (1895), No. 2, p. 9*).—The discovery is announced of a potash deposit on the boundary of Beyenrode, near Gifhorn, Hanover. It is a bed of kainit 20 to 30 meters thick and containing 27 per cent of chlorid of potassium. The deposit is calculated to contain 2,400,000,000 centner (about 132,000,000 tons) of the salt.

Commercial fertilizers, W. L. HUTCHINSON (*State Chemist Mississippi Bul. 6, pp. 12.*)—Notes on valuation and tabulated analyses and valuations of 37 official samples of fertilizers sent to the inspector by manufacturers, with a list of manufacturers' guaranties.

FIELD CROPS.

Millet, A. A. CROZIER (*Michigan Sta. Bul. 117, p. 64, figs. 6.*)

Synopsis.—The principal topics treated are the following: Character of soil; amount of seed; draft on soil fertility; curing, soiling, and pasturing millet; effect of millet hay on health of animals; weight, price, and uses of millet seed; diseases and enemies of millet; descriptions of cultivated forms or varieties, and yields of different kinds of millet.

In 1894 there were sown at the station 73 samples of millet seed, including 16 species and varieties. The dry season materially reduced the yields and altered the normal ripening period of the different varieties. Millet thrives best on a warm, loose, fertile soil. Where the soil is poor or where droughts prevail, broom corn millet and common millet are recommended as preferable to German millet; the first mentioned is specially recommended as resistant to drought.

The following table gives the yields of Hungarian grass hay on thirty second-acre plats on light, sandy soil and on loam when 1, 2, 4, and 6 pecks of seed per acre were sown:

[1] Office of Experiment Stations, Circulars 7 and 8.

Effect of amount of seed on yield of Hungarian grass hay.

	On light, sandy soil.	On heavy loam.
	Pounds.	*Pounds.*
One peck	70	65
Two pecks	41	78
Four pecks	42	74
Six pecks	39	49

Light seeding gave the best results. On another series of plats 3 pecks of seed per acre proved too much for all kinds of millet except broom corn millet, which has relatively large seeds. The author regards 2 pecks of seed as enough on ordinary soils for Hungarian grass, common millet, and German millet. For the production of seed 1 peck sown broadcast, or less if sown in drills, is recommended for all varieties except broom corn millet, of which 3 pecks is preferred.

As a crop for subduing weeds millet is regarded as superior to buckwheat. Millet has been satisfactorily used for soiling and pasturage. For pasturing Hungarian grass is preferred to common millet and German millet. Both timothy and a mixture of clover and timothy failed when sown with millet June 12.

Numerous quotations, representing conflicting opinions, are given as to the effect of millet hay on the health of live stock, especially of horses.

The diseases and enemies of millet are given as sorghum blight (*Bacillus sorghi*), millet smut (*Ustilago segetum* var.), and the chinch bug. Millet has been successfully used as a trap crop for this insect.

Common millet (*Setaria italica*) is small and early. Each root produces numerous slender stems with nodding, tapering heads, moderately compact above but loose at the base. The color of the heads is green, turning to a yellowish brown when ripe. The seeds are large, yellow, and oval.

Hungarian grass (*S. italica germanica*) is medium in maturity and has several stems from each root, erect or nearly erect heads, oblong, dark purple, bristly, and very compact; seeds oval, purple, mixed with yellow immature grains.

German millet (*S. italica*) is relatively late, has single or few large stems from each root; the head is usually nodding, and has purplish awns. The seeds are small, round, and yellow or golden.

Broom corn millet (*Panicum miliaceum*) has panicles resembling those of broom corn and generally grows about 2 feet high. It usually yields less fodder than other sorts, but is valuable both for forage and for seed in portions of the Northwest having short and dry seasons. "It stands drought remarkably well and is better adapted than any other kind to dry climates and poor soils."

Several cultural varieties of broom corn millet were grown, among them Japanese millet, which suffered from drought, but gave the largest yield of forage among the varieties of this group.

Golden Wonder millet (*S. italica*) has very long, tapering heads, with small green or sometimes rose-colored bristles. It is easily affected by drought, and rather late in maturing.

Other kinds of millet described are Missouri millet, California millet (*Setaria italica*), Italian millet (*S. italica*), Japanese millet (*S. italica*), Texas millet (*Panicum texanum*), sprouting millet (*P. proliferum geniculatum*), barnyard grass (*P. crusgalli*), sorghum (*Andropogon sorghum*), Johnson grass (*A. halapense*), and pearl millet (*Pennisetum typhoideum*).

A list of other species to which the name millet has also been applied is given. Tabulated data give number of seeds per gram, shape and size of seeds, and brief notes on the growth of all samples of millet tested.

On the quality of barley grown under different conditions, C. KRAUS and A. STELLWAAG (*Ztschr. landw. Ver. Bayern, 1894, pp. 164–171; abs. in Centbl. agr. Chem., 23 (1894), No. 10, pp. 667–670*).—As the barley grain becomes ripe its composition improves, the percentage of starch increasing and that of nitrogen decreasing. Heavy manuring, when it was accompanied by lodging of the straw, resulted in the formation of light grains with a high percentage of nitrogen and a low starch content. Among the barley grains of a single variety those were most glassy which contained a high percentage of protein, but the protein content was not the only factor concerned.

Cañaigre, E. W. HILGARD (*California Sta. Bul. 105, pp. 1–9*).—This is largely a résumé of all investigations heretofore published by the stations which have tested this crop. It appears that the deeper the tint of the foliage and the root the larger the percentage of tannin in the root, a fact which suggests possible improvement in cañaigre as has been effected in the case of the sugar beet. A comparison of the probable profits in growing black wattles and cañaigre is given, the result of the comparison being somewhat in favor of cañaigre. The following table gives the composition of the ash of cañaigre root, and for comparison the composition of the ash of the sugar beet:

Composition of ash of cañaigre root and sugar beet.

	Cañaigre.	Sugar beet.
	Per cent.	*Per cent.*
Silica	3.89	3.50
Potash	28.74	49.40
Soda	2.47	9.60
Lime	8.16	6.30
Magnesia	16.93	8.90
Brown oxid of manganese	0.98	....
Peroxid of iron and alumina	2.45	1.10
Phosphoric acid	18.19	14.30
Sulphuric acid	13.16	4.70
Chlorin	6.43	2.60
	101.40	100.40
Excess of oxygen due to chlorin	1.40	0.57
Total	100.00	99.83
Percentage of pure ash in dry root	4.48	4.35
Percentage of crude ash in dry root	4.79	5.44
Percentage of carbonic acid in crude ash	5.20	20.00
Percentage of total nitrogen in dry root	1.93	0.87

"Roughly speaking, we are probably justified in assuming that for equal weights of crop the cost of replacing the mineral soil ingredients by the purchase of fertilizers when necessary, will be about the same for both crops (cañaigre and sugar beets); while as regards nitrogen, our determination shows that the cañaigre draws nearly twice as heavily as the beet, so that a crop of 10 tons of fresh roots will take out of the soil nearly 100 lbs. of nitrogen per acre. In regular culture it should, therefore, probably be alternated with leguminous crops, that enrich the soil in nitrogen."

Corn as a silage crop, W. H. JORDAN (*Maine Sta. Rpt. 1893, pp. 57–63*).—This article contains the results of a comparison of silage made from Southern corn and Maine field corn, previously published as Bulletin 11 of the station (E. S. R., 6, p. 34), and a study of the ripening of silage corn. On each of 10 twentieth-acre plats one fifth of the area of corn was cut at 5 different dates. The following table gives the yield of green corn and of dry matter resulting from harvesting the crop at different stages of growth:

Yield of green corn and dry matter in an acre of corn at different stages of growth.

Date of cutting and condition of crop.	Days in each period of growth.	Yield of green corn per acre.	Dry matter.		Gain in weight in each period.	Rate of gain per day.
			In crop.	Yield per acre.		
		Pounds.	*Per cent.*	*Pounds.*	*Pounds.*	*Pounds.*
August 15, ears beginning to form	....	26,166	11.71	3,064.0	....	....
August 28, a few roasting ears	13	29,777	17.50	5,210.9	2,146.9	165.0
September 4, all roasting ears	7	31,000	19.55	6,060.5	849.6	121.3
September 12, some ears glazing	8	28,833	23.17	6,680.6	620.1	77.5
September 21, all ears glazed	9	27,777	25.34	7,639.7	358.1	39.8
Total increase after August 15	....	....	....	....	3,974.7	....

The following table gives the amounts of the different nutrients contained in the corn crop at different dates:

Yield per acre of different classes of nutrients of the corn plant at different stages of growth.

Date of cutting.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Sugars.	Starch.	Fat.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
August 15, ears beginning to form[1]	285.9	458.4	812.3	1,428	358.5	....	79.7
August 28, a few roasting ears	338.7	611.7	1,214.0	2,892	1,064.0	108	153.7
September 4, all roasting ears	376.3	689.6	1,192.0	3,621	1,248.0	297	181.8
September 12, some ears glazing	372.4	639.5	1,291.0	4,177	1,407.0	357	200.4
September 21, all ears glazed	416.1	649.8	1,309.0	4,457	1,161.0	1,083	208.4
Gain after August 15	130.2	191.4	496.7	3,029	802.5	1,083	128.7
Gain after August 28	77.4	38.1	95.0	1,565	97.0	975	54.7

[1] The manner of drying the sample taken from the lot cut at this period may have caused a loss of sugar.

"Two facts are clearly shown: First, that the later growth of dry matter in the corn plant is made up chiefly of non-nitrogenous compounds; and second, a large percentage of these compounds consisted of sugars and starch, substances that are the best of their class for the purposes of animal nutrition."

Variety tests of oats, H. J. WATERS and R. J. WELD (*Pennsylvania Sta. Rpt. 1893, pp. 116, 117*).—Fifteen varieties were tested in 1893 on duplicate twentieth-acre plats. Tabulated data give yields for each

year of all varieties tested. The average yields per acre for 1890, 1891, 1892, and 1893 were as follows:

Average yield per acre for 4 years of varieties of oats.

Variety.	Bushels.	Variety.	Bushels.
Baltic White	43.62	Early Russian	37.13
Japan	42.62	Henderson Clydesdale	36.89
Improved American	42.35	Welcome	35.59
German	41.03	Des Flandres	34.27
Scottish Chief	40.91	Jaune des Flandres	32.75
Wide Awake	39.13	White Bonanza	32.52
White Victoria	37.89	White Wonder	30.06
Haggett White Seizure	37.14		

Influence of maturity upon the yield of dry matter in soiling rye, H. J. WATERS (*Pennsylvania Sta. Rpt. 1893, pp. 52–54*).—This experiment was conducted on 9 plats each 6 by 100 ft. On 3 plats rye was cut just before heading, May 19; on 3 plats it was harvested when three quarters headed, May 24; on the other plats the crop was cut when in blossom, May 31. The rye cut before heading yielded 1,624.94 lbs. of dry matter per acre; that three quarters headed 2,702.79 lbs.; and that cut when in blossom 3,763.94 lbs. Assuming that the 3 lots of rye were equally digestible, the calculated yield of digestible matter per acre was as follows:

Yield of digestible matter per acre in rye cut at different stages of growth.

State of maturity.	Dry matter.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Before heading	1,189.3	68.58	160.29	369.1	555.3	36.05
Three fourths headed	1,986.5	96.22	212.54	696.0	937.0	44.71
In blossom	2,780.8	133.61	248.45	1,161.0	1,180.3	57.43

As much digestible dry matter was produced by 1 acre of rye cut when in bloom as by 2.34 acres cut 12 days previously and just before heading.

Australian salt bush, M. E. JAFFA (*California Sta. Bul. 105, pp. 10–16*).—The Australian salt bush (*Atriplex semibaccata*), grown at the Tulare Substation on some of the worst alkali spots on the grounds, yielded at the rate of about 5 tons of dry matter per acre. It is readily propagated by seed. Sheep and hogs eat the green plant readily, and horses and cattle soon get accustomed to it when mixed with other food at first. The following table gives the proximate composition of this plant:

Composition of Australian salt bush.

	Fresh.	Air-dried.	Water-free.
	Per cent.	*Per cent.*	*Per cent.*
Moisture	78.03	7.05	....
Albuminoids	2.75	11.64	12.53
Nitrogen-free extract	10.41	44.05	47.39
Fat	0.48	2.01	2.16
Fiber	3.75	15.88	17.08
Ash	4.58	19.37	20.84
Total	100.00	100.00	100.00

"The preceding analyses prove that this fodder is one of considerable merit."

The following table gives the composition of the ash:

Composition of the ash of Australian salt bush.

	Per cent.
Silica	16.24
Potash	11.42
Soda	35.39
Lime	5.79
Magnesia	3.23
Peroxid of iron	1.38
Alumina	1.95
Brown oxid of manganese	0.22
Phosphoric acid	2.80
Sulphuric acid	2.64
Chlorin	24.33
	105.35
Excess of oxygen due to chlorin	5.35
Total	100.00
Per cent of pure ash in air-dried substance	19.37

Although a ton of the air-dried plant contains nearly 14 lbs. of potash and 3½ lbs. of phosphoric acid, the fertilizing value of the ashes is more than balanced by the large amount of injurious alkali which it contains. A crop of 10,000 lbs. of dry salt bush removed 21.3 lbs. of potash, 5.93 lbs. of phosphoric acid, and 18.60 lbs. of nitrogen from the soil. By analyzing the alkali spots on which the plant was grown and the crop itself, it was found that a single crop of Australian salt bush removed 2.5 per cent of the total potassium sulphate in the soil, 2.99 per cent of the sodium chlorid, and 2.21 per cent of the sodium carbonate. "Soils where the percentages of alkali are near the limit of tolerance can no doubt be sensibly relieved by planting the salt bush and permanently removing each cutting from the land."

Fertilizer experiments with tobacco, W. FREAR (*Pennsylvania Sta. Rpt. 1893, pp. 82–112*).

Synopsis.—This is a report of progress on an experiment conducted by the station in coöperation with the Lancaster County Tobacco Growers' Society. Tabulated data give the yields of unfermented tobacco; the results are discussed at length.

General discussions on the tobacco crop, on the soil and climate of Lancaster County, and on the theory and practice of manuring the crop precede an account of the experiments conducted in 1893 at 2 localities in Lancaster County.

The questions investigated were: (1) Effects of phosphoric acid on limestone soils; (2) relative values of sulphate of potash and double carbonate of potash and magnesia; (3) cotton-seed meal, linseed meal, horn meal, and mixed cotton-seed meal and nitrate of soda as sources of nitrogen in complete fertilizers; (4) relative values of stable manure and chemical fertilizers; and (5) profit from the use of the above-mentioned fertilizers.

"As a basis of comparison it was determined that with a single exception all the artificial fertilizers should have the following composition:

	Per cent.	Pounds per acre.
Nitrogen	4.75	95
Phosphoric acid (available)	7.75	155
Potash (water soluble)	7.75	155

"This corresponded to the composition and quantity recommended for use in the case of one of the most popular tobacco manures."

This formula was of necessity not strictly followed in 1893. The fertilizers used cost at retail prices $27.22 to $41.77 per acre.

At Donegal the experiment occupied 20 twentieth-acre plats and at Rocky Springs 10 twentieth-acre plats, using duplicate plats in both localities.

At Donegal the soil was a limestone clay; the surface soil was 6 or 7 in. deep, and the subsoil a heavy yellow clay. Drought obscured the results. However, phosphoric acid appeared to increase the yield of leaf and of wrapper leaf. Double carbonate of potash and magnesia gave a slightly larger yield than sulphate of potash. The results from cotton-seed meal were regarded as slightly more favorable than those from linseed meal. Nitrate of soda (one-half applied interculturally) appeared to reduce the yield of wrappers. Barnyard manure showed no superiority over commercial fertilizers.

At Rocky Springs the soil was thin and "gravelly," belonging in the limestone class. Drought and hail vitiated the results. Here phosphoric acid was without marked effect.

The yield and quality of the fermented tobacco and the results of the chemical studies on the crops are to be published later.

Experiments with wheat, H. J. WATERS and R. J. WELD (*Pennsylvania Sta. Rpt. 1893, pp. 112–115, dgm. 1*).—These consisted of tests of varieties and of seed selected by hand in comparison with that from the threshing machine. No marked differences in yield resulted from the 2 classes of seed. On duplicate twentieth-acre plats 26 varieties of wheat were tested in 1892 and 33 varieties in 1893. Tabulated data give yields of every variety for each year tested. The average yields per acre for 1890, 1891, 1892, and 1893 were as follows:

Average yields of different varieties of wheat for 4 years.

Variety.	Bushels.	Variety.	Bushels.
Reliable	32.33	Extra Early Oakley	27.41
Valley	30.97	Diehl Mediterranean	27.25
Currell Prolific	30.97	Fultz	27.18
Deitz Longberry Red	30.84	German Emperor	26.98
Wyandotte Red	30.71	Mealy	26.86
Fulcaster	30.52	Nigger	26.08
Ontario Wonder	29.54	Deitz	25.98
Mediterranean	28.90	McGhee White	25.47
Theiss	28.35	Tuscan Island	25.19
Raub Black Prolific	28.23	Velvet Chaff	24.67
Democrat	28.08	Finley	24.30
Red Fultz	27.78	Improved Rice	23.18
Sibley New Golden	27.56	Miller Prolific	22.18

The culture of autumn catch crops, P. P. DEHÉRAIN (*Ann. Agron., 21 (1895), No. 1, pp. 5–16; abs. in Compt. Rend., 120 (1895), No. 2, pp. 59–64*).—The author had previously shown[1] that on soil kept entirely bare of vegetation the loss of nitrates through the drainage water was very considerable. In practice, however, after the removal of a grain crop, weeds and shelled grain germinate and afford some vegetation during the autumn. Hence he compared the amounts of nitrates lost in the drainage water of land covered with grass and that on which a crop of clover was growing. With grass the loss per hectare during the autumn of 1893 was 13.78 kg., with clover 22.18 kg. This heavy loss with both kinds of vegetation was attributed to the dryness of the summer of 1893 and to the fact that when the autumn rains came the plants were too feeble to appropriate all of the nitrates at their disposal. In 1894 the drainage water from the grass pots contained 9.76 kg. of nitric nitrogen per hectare, that from the clover pots 15.63 kg.

The office of catch crops is twofold, to take up nitrates during their growth and to supply nitrogenous matter to the soil after being plowed under. From the preceding figures grass was more active than clover in preventing the escape of the nitrates. However, clover when plowed under afforded 79.59 kg. of nitric nitrogen per hectare, while rye grass furnished only 55.15 kg., thus showing the superiority of clover as a crop for green manuring.

An investigation by M. Bréal confirmed the above results. He found in 1 kg. of soil which received no green manure 141 mg. of nitric nitrogen; in the same amount of soil in which rye grass had been turned under, 190.8 mg.; and in the same amount of soil in which alfalfa had been turned under, 289.4 mg.

In 1894 vetch sown on stubble in August and plowed under late in October or November afforded 78 to 90 kg. of nitric nitrogen per hectare, which is estimated as equal to 15,600 to 18,000 kg. of manure.

It was found that the dry matter of the roots of wheat contained a larger percentage of nitric nitrogen than that of rye grass and much more than that of clover.

The effect of chlorin compounds on yields of peas, grains, and potatoes, and on the starch content of potatoes, J. SCHULTE (*Magdeb. Ztg., 1894, No. 244; abs. in Centbl. agr. Chem., 23 (1894), No. 10, pp. 706, 707*).—The following chemicals were applied to peas, rye, barley, and potatoes: Calcium chlorid, magnesium chlorid, sodium chlorid, magnesium sulphate, and potassium sulphate. None of these chemicals reduced the yield of grain nor the percentage of starch in the potato tubers. Indeed, the yield of potato starch on the plat to which magnesium chlorid was applied was somewhat larger than on the untreated plat.

Fertilizer experiments on corn, oats, wheat, and grass, H. J. WATERS and R. J. WELD (*Pennsylvania Sta. Rpt. 1893, pp. 65–81*).—

[1] Ann Agron., 19 (1893), No. 7, pp. 305-338 (E. S. R., 5, p. 419).

This is a report on rotation experiments with corn, oats, wheat, and timothy and clover on 4 series of 36 eighth-acre plats, commenced in 1881.[1] All fertilizers were applied annually. Nitrogen was supplied at the rate of 24, 48, and 72 lbs. per acre in the form of dried blood, nitrate of soda, or sulphate of ammonia; also as barnyard manure, the amount of nitrogen in the latter not being determined. Phosphoric acid was supplied at the rate of 48 lbs. per acre in the form of dissolved bone-black. Potash was furnished at the rate of 100 lbs. per acre in muriate of potash. Gypsum, lime, ground limestone, and ground bone were also used in a few instances.

Tabulated data give for each plat the yields of corn, stover, oats, oat straw, wheat, wheat straw, and hay for 1892 and 1893, and the average yields of the 12 years during which the experiment has been in progress.

The following table gives the average increase in yield of the different crops during 12 years with complete fertilizers containing 24 lbs. per acre of nitrogen in different forms, and with complete fertilizers containing 24, 48, and 72 lbs. of nitrogen per acre:

Average increase in yield for 12 years with different fertilizers.

Fertilizer.	Corn.	Wheat.	Oats.	Timothy and clover.
	Bushels.	*Bushels.*	*Bushels.*	*Pounds.*
Dried blood and minerals	6.93	3.76	6.21	−80
Nitrate of soda and minerals	10.53	4.80	6.04	473
Sulphate of ammonia and minerals	13.28	5.90	6.54	666
24 lbs. of nitrogen and minerals	7.35	2.49	5.51	681
48 lbs. of nitrogen and minerals	8.73	5.03	7.03	545
72 lbs. of nitrogen and minerals	12.17	6.15	6.23	508
Barnyard manure	8.52	3.17	5.68	395

Notes on plants distributed by the station, E. J. WICKSON (*California Sta. Bul. 106, pp. 8, figs. 2*).—Brief descriptive notes on the most important plants distributed are given. *Polygonum sachalinense* "is a coarse plant and is not advocated as a substitute for well-known forage plants where the latter are satisfactory. For dry lands scant of useful growth the plant is commended for trial. It has a perennial root which withstands both drought and freezing of the ground." Australian salt bush (*Atriplex semibaccata*) made in Tulare County a wonderful growth on strongly alkaline soil. The flat pea (*Lathyrus sylvestris*), from reports received from growers, appears to be much valued in some parts of California. The following forage plants have been found the most satisfactory for dry soil, but are not offered as substitutes for better plants on naturally moist land: Tall oat grass (*Arrhenatherum avenaceum*), Schrader's brome grass (*Bromus unioloides*), Hungarian brome grass (*B. inermis*), Japanese wheat grass (*Agropyrum japonicum*), many-flowered millet grass (*Milium multiflorum*), hairy-flowered paspalum (*Paspalum dilatatum*), and Texas blue grass (*Poa arachnifera*).

[1] See also Report of the Station for 1890, p. 124 (E. S. R., 3, p. 718).

The square-pod pea (*Lotus tetragonolobus*) is an annual leguminous plant which at the station on 2 different plats yielded at the rate of 24 and 26 tons of green material per acre. Other plants for distribution are Jesuits' tea (*Psoralea glandulosa*), Persian table grapes, Italian wine grapes, olive cuttings or scions, tree tomato of Jamaica (*Solanum betaceum*), cañaigre, rice, sugar cane, 2 varieties of beans, 1 of wheat, zigzag corn, and New England spinach (*Tetragonia expansa*).

Cultural methods for improving the yield of barley, M. HOLLRUNG (*Ztschr. landw. Ver. Hessen, 1894, No. 52, pp. 424, 425*).

Beets running to seed, RIMPAU (*Deut. landw. Presse, 21 (1894), No. 102, pp. 984, 985*).—A discussion of the influences which cause certain biennial plants to form seed stems during the first year of growth.

Cañaigre, B. M. LELONG (*California State Bd. Hort. Rpt. 1893 and 1894, pp. 420–425, pls. 3, figs. 2*).—A general discussion of the culture of cañaigre (*Rumex hymenosepalus*), chiefly compiled from Arizona Station Bulletin 7 (E. S. R., 4, p. 804). Analyses of the root are given, and the plant and its roots and seeds are illustrated.

List of forage and miscellaneous plants under trial, O. LUGGER (*Minnesota Sta. Rpt. 1893, pp. 291–307*).—The author has under trial in small plats 546 forage and miscellaneous plants as follows: Grasses, 437 species; legumes, 92 species; and miscellaneous forage, textile, and oil-producing plants, 17 species. The object of the trials is to offer as many species as possible to the students for study and to ascertain what ones are adapted to the climate of the State. Nothing is given as to the relative value of the species tested.

Proximate analysis of upright brome grass (Bromus erectus), E. KINCH (*Agl. Students' Gaz., n. ser., 7 (1894), No. 2, p. 48*).

Sisal hemp in the Bahamas (*Kew Misc. Bul. 96, pp. 412–414*).

Fertilizer experiments on oats (*Agl. Students' Gaz., n. ser., 7 (1894), No. 2, pp. 39–42*).

Variety tests of potatoes, H. J. WATERS and R. J. WELD (*Pennsylvania Sta. Rpt. 1893, p. 117*).—The yields and brief descriptive notes are given in the form of tables for 12 varieties tested on twentieth-acre plats. The most productive was Early Puritan, followed by Green Mountain and Empire State.

Variety tests and experiments with green manures for potatoes, CROCHETELLE (*Ann. Agron., 21 (1895), No. 1, pp. 17–34*).

Increasing the harvest by selecting seed potatoes, A. SEMPOTOWSKI (*Deut. landw. Presse, 22 (1895), No. 3, p. 21*).

Storing and keeping potatoes, G. FABIUS (*Ind. Lait., 15 (1895), No. 2, p. 12*).

The soja bean, its origin, properties, and acclimatization, E. MARTIN (*Rev. Scientif., 3 (1895), ser. 4, No. 5, pp. 144–146*).

Soja beans, F. E. EMERY (*Southern Planter, 1895, Feb., pp. 56, 57*).

Sugar beets, H. SNYDER (*Minnesota Sta. Rpt. 1893, pp. 63–72*).—A reprint from Bulletin 27 of the station (E. S. R., 4, p. 723).

The Lahaina sugar cane (*Kew Misc. Bul. 96, pp. 418, 419*).

The introduction of tobacco into France, E. ROZE (*Jour. Bot. France, 8 (1894), No. 21 and 22, pp. 375–380*).—An historical sketch.

Experiments with wheat, A. C. MAGRUDER (*Oklahoma Sta. Bul. 12, pp. 4*).—These consisted of tests of varieties, dates of sowing, and an experiment in manuring wheat. On the manured portion of the field the variety making the largest yield was Currell; on the unmanured portion, Sibley Hybrid. Stable manure largely increased the yield. Wheat was sown at intervals of one week from September 7 to the following January. The largest yield resulted from the sowing made September 21.

Chemical investigation of seed wheat and of the wheat plant, H. SNYDER (*Minnesota Sta. Rpt. 1893, pp. 147–160*).—A reprint of Bulletin 29 of the station (E. S. R., 5, p. 867).

Experiments with wheat, oats, barley, corn, and potatoes, A. BOSS (*Minnesota Sta. Rpt. 1893, pp. 201–214*).—A reprint from Bulletin 31 of the station (E. S. R., 5, p. 1073).

Seed growing in Germany, E. SARSSON (*Gard. Chron., 17 (1895), ser. 3, p. 136*).—An account of the seed industry at the town of Quedlinburg.

Making silage by the use of Blunt's press, MÜLLER (*Ztschr. landw. Ver. Bayern, 84 (1894), Nov., pp. 868–872*).

HORTICULTURE.

Classification of the sexual affinities of Prunus americana vars., C. W. HEIDEMAN (*Expt. Sta. New Ulm, Minnesota, Rpt. 1894, pp. 10, pls. 2*).—This consists of a report of investigations upon the fertilization of plums, those used in the experiments being chiefly wild trees, although a few cultivated varieties were also employed. Numerous crosses were made, and a careful anatomical and physiological study of the pistils and anthers was undertaken, to determine the forms best adapted for self and cross fertilization and to ascertain the reasons of self and cross sterility. The flowers were found to fall in 3 groups, each with 2 subdivisions: Dichogamous, comprising proterogynous and proterandrous; Heterostyled, comprising long-styled and short-styled; and Bisexual, comprising gynodiœcious and andromœcious. The hermaphrodite form was found to be not common. The period of bloom usually lasts for 3 days to a week, although the actual time in the life of a blossom during which fertilization may be effected was found rarely to exceed 2 hours, beginning from 2 to 24 hours after the blossom has fully expanded.

The crosses between these various forms of flowers were found to vary greatly, in some cases not being possible. Reciprocal crosses were also found to vary in the intensity of fertilization. The term illegitimate is applied to such union of the reproductive elements as results in development of the ovary below the normal. Out of 49 possible combinations of pollination only 13 are considered legitimate, the others giving negative or but feeble results. Figures are given of the various forms of flowers and a diagram showing different ways in which fertilization can be accomplished.

Strawberry culture, W. B. ALWOOD (*Virginia Sta. Bul. 37, pp. 13–19*).—Descriptive and cultural notes and tabulated data on 39 varieties of strawberries grown on the station farm. The plants were mulched the previous fall with straw, which was not removed until the middle of April, thus sheltering the plants through the winter and until after the spring frosts. Uncovered plants bloomed in March and were killed by a severe freeze the latter part of the month. The rainfall was less than normal and the mean temperature of the spring was low, resulting in a reduced crop of berries, only about one third the average

yield being matured. Three tables are given, one showing the comparative yield of the varieties as determined from 6 plants of each sort, another giving the dates of bloom and fruit production and quality, and the third giving data for the 10 most productive varieties. Brandywine, Cyclone, Longfield, and Tennessee, comparatively new varieties, are considered among the best. A list of 134 varieties, tested up to date at the station, is given.

The grafting of grapes, E. G. LODEMAN (*New York Cornell Sta. Bul. 77, pp. 459–476, figs. 16*).

Synopsis.—Illustrated directions for the various methods of grafting grapes, with remarks on the physiology of grafting.

Introduction (pp. 459–464).—The structure of the grape stem is described and figured and the physiology of the combination of the stock and scion is given. It is urged that the scion be dormant or at least less active than the stock. Grafting is recommended to be performed either in the fall after the flow of sap has ceased, early in the spring before the flow has begun, or in late spring when the first activity of the sap has diminished. Early spring is considered as perhaps the most suitable time.

Methods of grafting (pp. 464–475).—Directions are given for making cleft grafts, crown grafts by inlaying, cutting grafts, modified tongue grafts, side grafts on stocks, and on root cuttings. The directions are given in detail and the implements and processes are fully illustrated. Cleft grafts are mentioned as being made by either completely or only partially severing the stock. Grape grafting is believed to be followed by better results if the scions are inserted below the surface of the ground. Cleft grafting and side grafting are considered the most suitable and satisfactory methods. Cuttings are best grafted by tongue graft.

A concise summary is given embodying the important points made in the bulletin.

Fruits, R. L. WATTS (*Tennessee Sta. Bul., vol. VII, No. 2, pp. 143–156*).

Synopsis.—Cultural and varietal notes on grapes, strawberries, raspberries, blackberries, pears, apples, and peaches.

Grapes (pp. 143-150).—Ninety varieties, comprising 391 vines, are being grown in the station vineyard, most of which fruited the past season. Brief descriptive notes are given on 31 varieties. The diseases, black rot and brown rot, attacking the vines and leaves, are briefly described, and directions for treatment by spraying with copper sulphate, Bordeaux mixture, or ammoniacal carbonate of copper are given; formulas for preparing these fungicides are included. The culture given the vineyard is briefly mentioned.

Strawberries (p. 150).—Brief notes on several varieties, the yield being greatly diminished by spring frost. Crescent, Haverland, Jessie, Windsor Chief, and Bubach were most productive.

Raspberries (pp. 150, 151).—Brief descriptive and comparative notes on the following varieties: Turner, Reliance, Golden Queen, Cuthbert, and Shaffer Colossal. The black caps were injured by frost and bore very scantily.

Blackberries (p. 151).—A list of 11 varieties, arranged in order of productiveness, Early Cluster and Kittatinny giving much the heaviest yields.

Pears (p. 151).—Notes on the culture of the pear orchard belonging to the station, the varieties Bartlett, Kieffer, and Beurre Giffard being planted.

Apples (pp. 152, 153).—Notes on work being done in the preparation of a catalogue of Tennessee apples. The fruit and foliage are photographed, and careful notes are made. In the case of promising seedlings, grafts are made upon bearing stocks in the station orchard. Coöperative work on the apples of the State is being done by numerous correspondents.

Peaches (pp. 153–155).—Notes on investigations in regard to peach growing in Tennessee, with brief recommendations for satisfactory culture. Information from peach growers of the State is requested in regard to various seedlings, soils, diseases, and culture.

A list of the donations to the horticultural division of the station in 1894 is appended.

Report of the horticulturist, W. M. MUNSON (*Maine Sta. Rpt. 1893, pp. 101–144, figs. 2*).

Synopsis.—This contains reports on the work of the year, comprising notes on cabbages, cauliflowers, tomatoes, eggplants, spraying experiments, and a catalogue of Maine fruits.

Cabbages (pp. 101–105).—Experiments were made to determine the influence of transplanting young plants, the effect of trimming at the time of setting in the field, and the result of holding plants in check. Plants twice handled in pots gave results slightly superior to those obtained from like plants handled the same number of times in boxes. In no case did the plants from boxes produce heads equal to the best of those from pots. The results obtained by reducing the amount of foliage at the time of setting in the field were almost negative. The results of 2 seasons' experiments indicated that little advantage is to be derived from the practice. Holding plants in check on account of severe weather by closely heading them back was found to render them earlier and slightly larger than others left untreated as checks. It is advised to prune the foliage of the plants likely to become drawn and crowded before planting out. The data for the experiments are tabulated.

Cauliflowers (pp. 105–111).—Chiefly a reprint of Bulletin 10 of the station (E. S. R., 6, p. 51). In addition are given tabulated data for the handling of cauliflowers in pots *vs.* boxes, the effect of trimming cauliflowers at the time of planting, and a comparison of 30 varieties of

cauliflowers. An increased percentage of marketable heads, amounting in some varieties to 20 per cent, was the result of handling the young plants in pots. In the experiment of trimming plants the per cent of heads formed was greater for plants not trimmed, though there was no difference in earliness or size of the heads. Early varieties produced more marketable heads than did the late, and where the heads produced were very large the percentage of plants heading was correspondingly small.

Tomatoes (pp. 112–118).—Chiefly a reprint of Bulletin 9 of the station (E. S. R., 6, p. 51), with the addition of tabulated data on the effect of early setting, value of pot culture, individual variation, and a comparison of first and second generations of crosses. Early setting is recommended, though the advantage gained in earliness and productiveness of fruit was but slight. Plants handled 3 times in pots showed a marked increase in productiveness over those transplanted a like number of times in boxes. The individual variation within varieties was found to be often so much as to obscure the effects of different methods of culture. A cross between the Ignotum and Peach varieties showed a marked falling off in the second generation over the advantage indicated by the first, although this may have been due to greater care given the first generation.

Eggplants (pp. 118–121).—Notes and tabulated data on early *vs.* late setting, deep *vs.* shallow cultivation, frequent cultivation, and the effects of root pruning. Early setting, when the plants escaped injury by frost, gave a large advance in the percentage of plants bearing marketable fruits, in the case of the Black Pekin variety amounting to 35 per cent. Deep cultivation with a horse hoe gave much better results than shallow hand work. Experiments with frequent cultivation were obscured by the failure of the varieties employed. Root pruning gave contradictory results.

Potatoes (pp. 121–124).—A reprint of Bulletin 12 of the station (E. S. R., 6, p. 632).

Spraying experiments (pp. 124–128).—A reprint of Bulletin 8 of the station (E. S. R., 5, p. 1077). In addition is given a table showing the details of an experiment in spraying to prevent apple scab, merely the results of which are given in the bulletin.

Catalogue of Maine fruits (pp. 129–144).—Tabulated data for 110 varieties of apples, 9 of crab apples, 14 of blackberries, 2 of dewberries, 20 of cherries, 10 of currants, 5 of gooseberries, 14 of grapes, 3 of quinces, 35 of pears, 29 of plums, 17 of raspberries, and 25 of strawberries. In addition, lists are given of the varieties believed to be profitable for the northern and southern counties of the State, and apples for home use and for market, with several varieties found unsatisfactory in the northern counties.

Small fruits in 1893, G. C. BUTZ (*Pennsylvania Sta. Rpt. 1893, pp. 118–126*).—Cultural and descriptive notes and tabulated data for 34

varieties of strawberries, 20 of raspberries, 10 of blackberries, 9 of currants, and 6 of gooseberries. Greenville and Shuster Gem gave the heaviest yield of strawberries, and the total yield from mats was 10 per cent better than that from hills. Of raspberries Caroline, Brinkle Orange, Marlboro, Cuthbert, Rancocas, Shaffer Colossal, Souhegan, Mammoth Cluster, and Ohio are recommended as the best of the different colors they represent. Early Harvest, Eldorado, Jewett, and Snyder proved the best blackberries; and the Cherry, Red Dutch, and White Grape were the most productive currants. The Smith gooseberry yielded the most fruit, followed closely by the Houghton.

Manuring of fruit trees, LIERKE (*Mitt. deut. landw. Ges., 1893–'94, No. 12, pp. 167–171; abs. in Centbl. agr. Chem., 23 (1894), No. 10, pp. 702, 703*).—Notes on fertilizer experiments begun in 1891 under the direction of the Dresden Agricultural Experiment Station, in orchards on the manor of Rottwerndorf. Twenty-three plats were employed, being treated with various animal manures and different combinations and quantities of chemical fertilizers. At this time the nitrogen and potash fertilizers seem to be producing too vigorous a growth of foliage and shoots, to the detriment of the fruit, but the results are not yet established or conclusive, and the experiments are to be further pursued.

On the manuring of fruit and garden crops and the relation of live stock to fertility, J. W. FIELDS (*Pennsylvania Sta. Rpt. 1893, pp. 61–65*).—A general, popular paper on intelligent horticultural fertilizing. Tables are given showing the fertilizing content of the more common orchard and small fruits and garden vegetables. In growing these crops the return of nitrogen to the soil is urged to be as essential as the return of potash and phosphoric acid, an amount approximating that removed, depending on the nature of the soil and its natural fertility, being returned. A formula is given for a general fertilizer. The value of manure from farm animals in returning to the soil the fertilizing constituents taken from it by the crops is briefly mentioned, and a table is given showing the number of pounds of fertilizing ingredients in a ton of various farm products, and some commercial feeding stuffs with their fertilizing value per ton.

Tests of vegetables in 1893, G. C. BUTTS and G. BALDWIN (*Pennsylvania Sta. Rpt. 1893, pp. 126–142*). Descriptive notes and tabulated data on 6 varieties of bush Lima beans, 6 of bush beans, 6 of pole beans, 6 of beets, 1 of celery, 7 of early cabbage, 4 of late cabbage, 11 of corn, 9 of cucumbers, 11 of lettuce, 7 of onions, 16 of peas, 10 of squash, and 25 of tomatoes. A list of donations to the horticultural division of the station during 1893 is appended.

Glasshouses, their construction and heating, H. W. GIBBONS (*Amer. Florist, 10 (1895), No. 350, pp. 377, 378*).—Detailed architectural directions for building plant houses.

Horse-radish, G. M. STRATTON (*Amer. Gard., 16 (1895), No. 32, p. 54*).—Detailed cultural notes.

The cultivation of the melon, W. PALMER (*Jour. Hort., 1895, No. 2419, pp. 118, 119, fig. 1*).—A popular article on growing melons in hothouses in England, giving full directions for producing prize fruit. The illustration is from a photograph of a plant of the Triumph variety, loaded down with fruit, and supported on wires.

Edible and poisonous mushrooms, C. COOKE (*London: 1894, pp. 126, figs. 18*).—Reviewed in *Rev. Scientif., 10 (1895), No. 3, p. 84.*

Edible fungi in Surrey, C. A. BRIGGS (*Sci. Gos., n. ser., 1 (1895), No. 11, pp. 251, 252*).—The author mentions the following species as edible: *Agaricus campestris, A. arvensis, A. gambosus, A. rubescens, A. vaginatus, A. prunulus orcella, A. personatus, A. nudus, Boletus lutens, Lycoperdon plumbeum, L. bovista, Morchella esculenta, Sparassis crispa,* and *Fistulina hepatica,* all of which he says are easily recognized and very palatable.

Rhubarb (*Amer. Gard., 16 (1895), No. 32, p. 46, fig. 1*).—Brief notes on planting, fertilizing, and marketing.

Sago cultivation in Borneo (*Kew Misc. Bul. 96, pp. 414–417*).

The apricot, B. M. LELONG (*California State Bd. Hort. Rpt. 1893 and 1894, pp. 29–55, figs. 12*).—An elaborate paper treating of the origin of the apricot, its propagation, soil, planting, pruning, thinning, fruit picking, grading, cutting for drying, sulphuring, drying, sweating, packing the dried fruit, and illustrated, descriptive, and comparative notes on 35 varieties. Notes from various growers in the State bearing on different points are included. California is believed to be peculiarly adapted to the apricot. Special stress is laid on the preparation of the dried fruit. Illustrations are given of apricot trees and orchards, showing the manner of growth and the effect of proper pruning.

The cherry, B. M. LELONG (*California State Bd. Hort. Rpt. 1893 and 1894, pp. 55–63, pls. 19, figs. 2*).—Notes on the growing of cherries in California, with remarks on the soil, propagation, planting, pruning, cultivation, picking and packing, diseases and pests, and illustrations of 26 leading varieties, many of which are figured for the first time. The pits of 31 varieties are figured to show the different types of form for classification purposes. The rich valley lands of the State are the principal cherry producing sections, and a number of valuable varieties have been originated in California. Notes from several cherry growers of the State are incorporated.

Fig culture and fig packing, D. SHERMAN (*California State Bd. Hort. Rpt. 1893 and 1894, pp. 234–236*).—Notes on the cultivation, gathering, processing, and packing of figs, the different steps of the preparation for market being given in detail.

Curing the white Adriatic fig, G. A. RAYMOND (*California State Bd. Hort. Rpt. 1893 and 1894, pp. 270–272*).—A detailed account of the method of curing this variety of fig employed by the author.

The pomelo, B. M. LELONG (*California State Bd. Hort. Rpt. 1893 and 1894, pp. 63–65*).—Brief descriptive remarks on *Citrus pomelanus* and its value as a medicinal fruit. Several newspaper articles are included. The cultivation of the pomelo in California is urged.

Prune culture from a commercial standpoint, J. E. GORDON (*California State Bd. Hort. Rpt. 1893 and 1894, pp. 204–213*).—A general paper on the growing of prunes, embodying earnest recommendations as to the best methods of cultivating, picking, drying, and marketing.

The mulberry, G. ABBEY (*Jour. Hort., 1895, No. 2419, pp. 112, 113*).—A popular paper on the cultivation and uses of the tree, leaves, and fruit, including an historical sketch.

The buffalo berry, L. C. CORBETT (*Amer. Gard., 16 (1895), No. 32, p. 45, figs. 2*).—An illustrated article pointing out the distinction between the staminate and pistillate forms of *Shepherdia argentea.* The paper was read at the last meeting of the Association of American Agricultural Colleges and Experiment Stations.

Dewberries are worth cultivating, I. N. STONE (*Amer. Gard., 16 (1895), No. 32, p. 45*).—Brief notes on the growing of dewberries, the variety Bartel being preferred to Lucretia, as it is more prolific and nearly thornless.

Rubus australis, W. J. BEAN (*The Garden, 47 (1895), No. 1212, p. 100, fig. 1*).—Descriptive notes on this New Zealand bramble, which is advised as an addition to cool conservatories.

Cross fertilization of grapes, S. B. GREEN (*Minnesota Sta. Rpt. 1893, pp. 229–231, fig. 1*).—A reprint from Bulletin 32 of the station (E. S. R. 6, p. 46).

Pot grapevines vs. planted canes, G. WYTHES (*Gard. Chron., 17 (1895), ser. 3, p. 176*).

The importance of hybrids in replanting vineyards, A. MILLARDET (*Compt. Rend., 119 (1894), No. 26, pp. 1176–1180*).

Three years' observations on the action of plaster in viticulture, G. BATTANCHON (*Prog. Agr. et Vit.; L'Engrais, 10 (1895), No. 5, pp. 114, 115*).

Fruits and soils of the arid region, E. W. HILGARD (*California State Bd. Hort. Rpt. 1893 and 1894, pp. 303–312*).—A paper embodying the results of over a thousand analyses of soils from arid regions. Compared with analyses of humid soils, the arid lands possess about 3 times as much potash and 12 to 14 times as much lime, while there is no material difference in phosphoric acid. Analyses of fruits indicate that those grown in arid regions were of better quality, particularly possessing more sugar. Attention is drawn to the fact that the earliest civilization originated in localities with but scanty rainfall, such as Egypt and India. Some of the analyses of soils of the United States are tabulated.

Fruits, notes on varieties, S. B. GREEN (*Minnesota Sta. Rpt. 1893, pp. 239–247*).—A reprint from Bulletin 32 of the station (E. S. R. 6, p. 55).

Fruit forcing (*Jour. Hort., 1895, No. 2419, pp. 124, 125*).—Brief directions for forcing pineapples, figs, cherries, strawberries, cucumbers, and melons in hothouses.

Thinning fruit (*California State Bd. Hort. Rpt. 1893 and 1894, pp. 341–343*).—A general discussion of the subject and the extent to which it should be pursued in different kinds of fruits.

Orchard fertilization, A. S. CHAPMAN (*California State Bd. Hort. Rpt. 1893 and 1894, pp. 313, 314*).—Notes on experiments in using different fertilizers on a sandy soil for the raising of citrus fruits and grapes. Potash fertilizers gave the best results.

Irrigation for the development of fruit, H. A. BRAINARD (*California State Bd. Hort. Rpt. 1893 and 1894, pp. 216–220*).—A discussion of the value of irrigation in fruit raising, and recommendations for its adoption and extension.

Fruit growing in the Santa Maria Valley, O. W. MAULSBY (*California State Bd. Hort. Rpt. 1893 and 1894, pp. 221–223*).—A general discussion of the subject, with a consideration of the soil and climate. Apricots, prunes, English walnuts, peaches, almonds, and cherries are grown in the order given.

Notes on fruit growing at Mildura, A. H. BENSON (*Agl. Gaz. N. S. W., 5 (1894), No. 11, pp. 765–772*).—General notes on the growing of citrus and other fruits in this part of Australia, with remarks on the varieties found best, and on the climate, soil, irrigation, cultivation, and drying of the crops.

Suggestions on horticultural quarantine, A. CRAW (*California State Bd. Hort. Rpt. 1893 and 1894, pp. 290–294*).—General remarks on the subject, laws bearing on it, and its enforcement.

California almonds (*California State Bd. Hort. Rpt. 1893 and 1894, pp. 417–419, pls. 4, fig. 1*).—Descriptive notes on 13 varieties of almonds which are divided into 4 grades, hard shell, soft shell, extra soft shell, and paper shell. A table is given showing the weight of the kernel and shell in a pound of almonds of 12 different varieties, and the relative value of leading California varieties compared with others.

The pistachio (Pistacia vera), G. HEUZÉ (*Jour. Agr. Prat., 59 (1895), No. 4, pp. 143, 144*).

Pecan culture in the arid regions, F. A. SWINDEN (*Irrigation Age, 8 (1895), No. 2, pp. 54, 55, figs. 5*).

Some desirable ornamental trees, shrubs, and plants for planting in Ontario, W. E. SAUNDERS (*Ontario Fruit Growers' Assn. Rpt. 1893, pp. 90–97*).—General remarks on these subjects, with comparative cultural notes on several species of pine, spruces, retinosporas, maples, horse-chestnuts, alders, birches, yellowwood, walnuts, maidenhair tree, oak, false indigo, flowering almond, Siberian pea, dogwoods, mock orange, spiræas, and other trees and shrubs.

FORESTRY.

Five years' experience in planting forest trees, W. A. BUCKHOUT (*Pennsylvania Sta. Rpt. 1893, pp. 153–155*).—Experiments have been in progress to test tree and seed planting at the college grounds and on a small area of wild land. The details of preparation and planting were given in the report of the station for 1888 (E. S. Bul. 2, pt. 2, p. 136). The results have not been wholly satisfactory. The mountain plat proved not well adapted to the purpose, as the undershrubs crowded out that which was planted. The chestnut trees failed entirely in the mountain plat and grew very poorly at the college. A reason for this is that the ground was too loose and permitted the deep taproot to dry out before the lateral roots were developed. The white pine trees at the college made the best growth, averaging 4 to 5 ft. in height. The mountain planting of the same kind of trees gave smaller, weak trees, which are not well established. The principal injury to these trees was done by the pine weevil (*Pissodes strobi*) and the woolly pine louse (*Schizoneura pinicola*).

The author concludes that considering the time, expense, and risk involved, artificial forest planting can not be recommended, at least in the way pursued in the experiment, and that natural methods of reforesting, supplemented by some seed sowing, thinning, and planting, will suffice for the present and the near future.

Experience with evergreens in Pennsylvania, G. C. BUTZ (*Pennsylvania Sta. Rpt. 1893, pp. 142–149, pl. 1*).—A reprint from Bulletin 23 of the station (E. S. R., 5, p. 54).

The long leaf pine and its struggle for existence, W. W. ASHE (*Jour. Elisha Mitchell Sci. Soc., 11 (1894), No. 1, pp. 1–16*).

The planting of beech trees, P. HAUGUEL (*Rev. Hort., 66 (1894), No. 24, pp. 584, 585*).—General notes on this point.

The black walnut in the West, C. A. KEFFER (*Garden and Forest, 8 (1895), p. 12*).

The green ash in the West, C. A. KEFFER (*Garden and Forest, 8 (1895), p. 32*).

The white elm in the West, C. A. KEFFER (*Garden and Forest, 8 (1895), p. 53*).—This tree is recommended as a forest tree for the West on account of its resistant powers and rapid growth.

The New South Wales blue gum, J. H. MAIDEN (*Agl. Gaz. N. S. W., 5 (1894), No. 11, pp. 743–747, pl. 1*).—Illustrated and descriptive and economic notes on *Eucalyptus saligna*.

Notes on the tree flora of Chiricahua Mountains, I, J. W. TOUMEY (*Garden and Forest, 8 (1895), pp. 12, 13*).—An account of a botanical excursion through northern Mexico and southern Arizona.

A descriptive list of the trees of Java, S. H. KOORDERS (*Mededeelingen 'SLands Plantentuin, 1894, No. 12, pp. 175*).

Water and forestry and agricultural production, L. GRANDEAU (*Jour. Agr. Prat., 59 (1895), No. 2, pp. 50–52*).—A brief résumé of the work of Henry Schübler, Schlösing, and Wollny.

Forest conservation, A. KINNEY (*California State Bd. Hort. Rpt. 1893 and 1894, pp. 326–328*).—A general popular article urging the importance of the preservation of forests from destruction and their influence on rainfall. Federal control of forest lands is advocated.

Ringbarking in western New South Wales, T. KIDSTON (*Agl. Gaz. N. S. W., 5 (1894), No. 11, pp. 762–764*).—Notes on removing forests by the employment of this method of deadening the trees. The author does not believe that the destruction of forests lessens rainfall.

Forest fires, W. A. BUCKHOUT (*Pennsylvania Sta. Rpt. 1893, pp. 155–159, fig. 1*).—A reprint from Bulletin 23 of the station (E. S. R., 5, p. 54).

Forest fires in North America, B. E. FERNOW (*Ztschr. Forst. und Jagdw., 17 (1895), No. 1, pp. 31–35*).

Forest fires, causes and preventions (*Forest Leaves, 5 (1895), No. 1, p. 15*).—An abstract from the *Boston Commercial Bulletin*, giving statistics on the subjects, number of fires, acres burned, loss, etc.

Fire and flood, J. T. ROTHROCK (*Forest Leaves, 5 (1895), No. 1, pp. 8, 9, pls. 2*).—An article dealing with the destruction of forests in Pennsylvania and discussing the injury to the soil and property. The plates are from photographs, showing the tracks of forest fires and freshets.

Forest destruction by means of Gryllus campestris and Tettix subulata, ALTUM (*Ztschr. Forst. und Jagdw., 17 (1895), No. 1, pp. 12–17*).

Thirteenth Annual Meeting of the American Forestry Association, B. E. FERNOW (*Forest Leaves, 5 (1895) No. 1, pp. 10, 11*).—A general account of the proceedings of the meeting, with the resolutions adopted favoring forest legislation.

California Forestry Experiment Stations, II, C. H. SHINN (*Garden and Forest, 8 (1895), pp. 62, 63*).—A description of the Santa Monica forestry station.

Forestry in Natal (*Kew Misc. Bul. 97, pp. 1–5*).

SEEDS—WEEDS.

Seed testing, its uses and methods, G. MCCARTHY (*North Carolina Sta. Bul. 108, pp. 347–415, figs. 44*).—The author has brought together from various sources a fund of information relating to the subject of seed testing. The necessity and uses of seed testing are pointed out and a brief review of what has been done in the United States is given, together with a statement of the seed control system of Europe and the methods by which it is conducted. Numerous tables are given showing the viability, genuineness, and value of different kinds of seed. A chapter on the physiology of the seed gives briefly the structure, germination, composition, effect of temperature, light, electricity, and chemicals on germination, specific gravity and volume weight of seed, and the life period of the embryo. In the chapter on practical seed testing are given compiled tables showing the viability, purity, and germination of a large list of forage plants, field and garden crops, and flower seed; the impurities and adulterations of seed and the limits of error in testing, and descriptions of apparatus and methods employed in seed testing. The author has drawn on the various station publications of this country as well as the leading seed control stations of Europe for the facts set forth in this bulletin.

New Mexico weeds, I, E. O. WOOTON (*New Mexico Sta. Bul. 13, pp. 36, figs. 15*).—This bulletin is the first of a series to be devoted to the subject of the weeds of New Mexico, and gives some general information on weed dissemination and repression. The list enumerated embraces 18 species, as follows, the most of which are figured: Nigger

weed (*Sphæralcea angustifolia*), *Sida hederacea*, *Gaura parviflora*, blue weed (*Helianthus ciliaris*), sunflower (*H. annuus*), cocklebur (*Xanthium canadense*), spiny aster (*Aster spinosus*), *Franseria hookeriana*, *Aster canescens*, morning glory (*Ipomœa mexicana* and *I. purpurea*), horse nettle (*Solanum elæagnifolium*), common pigweed or rough amaranth (*Amarantus retroflexus*), rough amaranth (*A. chlorostachys*), low amaranth (*A. blitoides*), lamb's quarter or goosefoot (*Chenopodium album*), sand bur or bur grass (*Cenchrus tribuloides*), *Chloris alba*, and loco weed (*Astragalus mollissimus*).

Western plantain, F. L. HARVEY (*Maine Sta. Rpt. 1893, pp. 157, 158, fig. 1*).—A description and illustrations of *Plantago patagonica aristata* are given, with a report of its appearance in an oat field during the year. The author calls attention to this weed being an annual, and suggests its easy eradication by preventing its setting seed.

The Russian thistle, L. H. DEWEY (*U. S. Dept. Agr., Division of Botany Circular 3, pp. 8, figs 3*).—Popular information is given on the nature, distribution, and remedies for this weed. It is now known to be present in 18 States, and also in 3 of the Canadian provinces.

The sachalin knot weed, L. H. PAMMEL (*Garden and Forest, 8 (1895), p. 67*).—The author refers to 12 years' experience with this plant, and says it spreads very rapidly by means of its rhizomes, and land set in it may have to be given up to it as in the case of the Johnson grass in the South.

DISEASES OF PLANTS.

Some grape troubles of western New York, E. G. LODEMAN (*New York Cornell Sta. Bul. 76, pp. 413–454, figs. 6*).

Synopsis.—The author describes and offers suggestions for the repression of shelling or rattling (a disease of rather uncertain origin), powdery mildew, anthracnose, black rot, brown rot or gray rot, and ripe rot. Brief notes on spraying apparatus and formulas for 3 of the best fungicides are given.

Shelling or rattling (pp. 413–440).—This disease, which although not new was more or less troublesome throughout the grape-growing portions of the State, is characterized by the author as follows:

"The shelling of grapes takes place in the following manner. As the season of ripening approaches, certain berries of the affected clusters fall to the ground on account of the inability of the main fibers and other connecting tissue of the fruit-stems to sustain their weight. . . . The end of the stem is even, as if cut with a knife.

"The portions of the cluster first affected are, so far as my observations go, invariably either the lower extremity of the cluster as it hangs from the cane, or in the case of heavily shouldered clusters, the outer extremity of the stem forming the shoulder. The shelling may begin at both points at about the same time, but it generally makes its appearance first at the lower end of the bunch. Sometimes only one or two berries may fall, but in other cases the drying and shriveling of the stem gradually extends upward, the affected portion being plainly marked by the absence of the berries. It often occurs that not a berry remains hanging upon the bunch. In such cases the ground below the bearing portions of the vine is literally covered with the fallen fruit. . . .

"Some clusters upon a vine seem to be more free from shelling than others upon the same plant. This seems to be due in many cases to its location upon the cane, but there are so many exceptions that no definite rule can be laid down. In general, however, it may be said that of the clusters found upon a certain cane the one which is situated farthest from the main stem of the plant is most seriously affected. . . .

"Another peculiarity which may sometimes be seen, although cases of it are very rare, is the shelling of berries upon only one portion of the vine, as, for instance, those borne upon the canes which spring from an arm, the difficulty thus affecting only one half of the plant. . . .

"It very commonly occurs that plants in certain portions of a vineyard shell, while the large majority of them do not. The line is sometimes so sharply drawn that the affected plant may be entirely surrounded by healthy vines; and it is not uncommon to find a healthy vine in the midst of those which shell. Occasionally the plants in a row are quite different as regards the amount of fruit which is lost, some retaining all, while others lose fully 75 per cent. Such vineyards, however, do not represent the large majority. In these, the shelling is more or less uniform throughout the vineyard, and only in exceptional cases does the loss reach 50 per cent of the crop. The total loss will probably not exceed 5 per cent of the entire yield this year.

"The taste of shelled grapes differs decidedly from that of those remaining upon the upper portion of affected clusters, and still more from that of berries which are borne upon vines in which no shelling takes place. This difference is very noticeable in Concords. Grapes of this variety, when grown under favorable conditions, are sweet and very agreeable to the taste, on account of a flavor which is peculiar to the variety. Shelled grapes are extremely insipid, and are unpalatable, not only from a want of taste but also from a certain disagreeable flavor which, though seldom strong, is still perceptible. Berries which remain upon shelly vines lack flavor, but otherwise they do not appear to possess any particularly disagreeable qualities."

Vines which have shelly grapes are said to be nearly always affected by diseased foliage. This condition usually appearing in July or August, causes the death of the leaf tissues. The leaves on the extremities of the shoots show a yellow coloration more or less following their periphery. Soon the yellow portion turns brown, causing the leaf to curl. In severe cases the brown foliage becomes conspicuous. The shelling is not always accompanied by a decided discoloration, but the two are usually associated. A dark discoloration is often found between the principal veins and is attributed to the same cause as that causing the death of the edges. In some of its aspects this disease resembles apoplexy and rougeot, common in parts of Europe, but the author doubts their identity. In 1890 D. G. Fairchild, of the Division of Vegetable Pathology of this Department, investigated and reported on[1] a disease of grapes probably the same as here described.

The ascribed causes of the shelling are grouped by the author under 4 heads—(1) injuries due to parasites, (2) improper conditions of the vine, (3) conditions of the soil, and (4) conditions of the atmosphere. In considering the various causes the author thinks that insects do not cause the disease, but that fungi may aggravate it, and that the dying of the leaves is a manifestation of the disease. The conditions of the vine, causing the stems to shrivel and the fruit to ripen prematurely probably cause this trouble. Premature ripening of the wood and overbearing

[1] Jour. Mycol., vol. 6, p. 96 (E. S. R., 2, p. 455).

weaken the vine and may to some extent cause shelling. Too much wood, due to improper proportion of the elements required for the plant, especially a superabundance of nitrogen, seems to increase the amount of shelling. The kind of soil, not considering the food supply it contains, appears to have no effect, but too much cultivation, by liberating the nitrogenous compounds, aggravates the trouble. Excessive drought and rains influence the amount of disease to some extent. A weak root system has the same effect as overbearing. The disease has been checked by applications of barnyard manure. A lack of phosphoric acid has no effect. In most cases the plants seem to be suffering from a lack of potash, and applications of that fertilizer have been followed by a decrease or disappearance of the disease. Excessive heat and warm winds, by inducing rapid growth, increase shelling, while cool winds or weather checks it. From reports received from quite a number of vineyardists the application of potash to the vines checked shelling, and based on only one year's experience this treatment is recommended.

Powdery mildew (p. 441).—This disease prevailed to a considerable extent during 1894 in the Chautauqua vineyards. The application of Bordeaux mixture or ammoniacal copper carbonate is recommended as a treatment.

Anthracnose (pp. 442, 443).—This disease has been very severe on Moore Diamond and Brighton varieties, and it is recommended that growers make a trial of the acid sulphate of iron solution, the formula for which is iron sulphate 110 lbs., sulphuric acid 1 qt., water 26 gal.

Black rot, brown or gray rot, and ripe rot (pp. 444–448).—These diseases were somewhat prevalent in certain regions, and the usual fungicides are recommended. The reported failure of some vineyardists to prevent these diseases was due, the author thinks, to too thick foliage and improper application of fungicides. In some vineyards the vines suffered from drought. For these shallow and frequent cultivation is advised.

Spraying apparatus (p. 450).—Different forms of apparatus are described. The knapsack machine is considered the most effective. Hand pumps, the author says, allow of more rapid but less efficient work, while power sprayers are, under favorable circumstances, the most desirable for use in vineyards.

Formulas for fungicides (pp. 450, 451).—Formulas are given, together with directions for preparation for Bordeaux mixture, ammoniacal copper carbonate solution, and acid iron sulphate solution.

Report of botanist, F. L. HARVEY (*Maine Sta. Rpt. 1893, pp. 145, 146, 150, 152–158, figs. 5*).

Synopsis.—The author reports briefly on the fungus diseases occuring during the year, and at greater length on bean anthracnose, tomato anthracnose, potato and beet scab, and western plantain. In addition to the diseases reported on at some length, the following have been more or less prevalent in parts of the State: Pear leaf blight, clover rust, and strawberry septoria.

Bean anthracnose (pp. 152, 153).—This disease, due to the presence of *Colletotrichum lindemuthianum*, has been quite common, attacking both bush and pole varieties of beans, but being most destructive to the white-podded varieties. The disease is described and the following precautions are given for preventing the spread of the disease:

"Select good seed, rejecting all beans that seem at all unsound.

"Should the disease appear in the young beans carefully destroy all affected seedlings.

"If convenient spray early with Bordeaux mixture and repeat the application, if needed, before the pods form.

"Do not plant on ground that has borne an infected crop the past season.

"Plant on a dry soil in hills or in rows far enough apart to admit air freely. Hoe when the ground and foliage are dry."

Tomato anthracnose (pp. 154, 155).—This disease, which caused considerable destruction in the station garden, was described in the Annual Report of the Delaware Station for 1891, p. 60 (E. S. R., 5, p. 591), as *Colletotrichum lycopersici*, but is here called *C. phomoides*. The disease appears on the ripe or nearly ripe fruit, producing discolored sunken spots with black centers. Successful inoculations have been made, but placing spores on the unbroken epidermis of the tomato failed to produce the disease. A spray of potassium sulphid solution, 7 oz. in 22 gal. of water, together with the destruction of all diseased plants and rotation of crops, are the remedies recommended.

Potato and beet scab (p. 156).—Compiled notes are given showing the identity of these diseases, and the corrosive sublimate treatment is recommended for their prevention.

Miscellaneous botanical work, W. A. BUCKHOUT (*Pennsylvania Sta. Rpt. 1893, pp. 150–153, pl. 1*).—*Experiments for preventing potato diseases* (pp. 150–152).—Experiments were conducted with Bordeaux mixture for the prevention of potato rot with negative results, no blight or rot appearing on any of the plants. The sprayed plants showed a more vigorous appearance of their tops than the unsprayed. The effect of early planting was tried. Plats were planted April 28 and May 7. There was a marked difference in the appearance of the plants until August, when there was little or no appreciable difference. Owing to the hot dry weather of midsummer there was no disease present. When harvested the early plat yielded 1,100 lbs. to 882 from the later planted one. These experiments were to have been repeated in 1893 to see if the same results would be secured, but were overlooked. As the rot does not usually appear until late in July the experiment of early planting is to be investigated further.

Spraying grapes (p. 152).—In 1891 10 varieties of grapes not sprayed were observed, and downy mildew was conspicuous on the Delaware, Brighton, Duchess, Lindley, and Salem varieties. In 1892 the growth of these varieties started very slowly, the Brighton and Duchess vines being nearly dead. Three applications of Bordeaux mixture were given the vines with negative results, there being no mildew that year. In

1893 the experiments were repeated with the same results, and the difference between the sprayed and unsprayed portions of the rows was indistinguishable. A Niagara vine within the sprayed portion showed some black rot, all others being free from the disease. Unsprayed Concord vines produced a full crop free from disease each year.

Leaf spot of beet (pp. 152, 153).—This disease, due to *Cercospora beticola*, was very noticeable. The author thinks spraying would probably prevent it, also that the same result would be secured by a rotation of crops, together with a thorough destruction by fire of all infected leaves upon the ground where grown in such a way as to burn the surface of the ground slightly, destroying the weeds and accumulated rubbish. The injury to the roots is said to be in a direct ratio to the amount of spotting on the leaves.

Wheat scab (p. 153).—This disease is reported as having been more or less abundant, but no experiments were conducted for its repression.

An infection experiment with club root of turnips (finger and toe disease), W. SOMERVILLE (*Jour. Roy. Agl. Soc. England, ser. 3, 5 (1894), No. 20, pp. 808–811, fig. 1*).—The author reports on field experiments with lime for the prevention of club root (*Plasmodiophora brassicæ*) of turnips. The turnips were grown in soil that was not infected in small duplicate plats. The infection was secured by adding to each plat 20 lbs. of soil taken from a field known to be badly infested. Finely ground fresh lime was added to the inoculation soil in $\frac{1}{8}$, $\frac{1}{4}$, 1, and 5 per cent amounts. The lime was ground to such a degree that 90 per cent passed through a number 100 sieve. The yields given were as follows:

Soil inoculation experiment with club root.

Plat.	Infected soil.	Per cent of lime to infected soil.	Number of roots.	Number of diseased roots.	Number of sound roots.	Calculated yield per acre.
	Pounds.					*Bushels.*
1	0	0	42	0	42	354
2	20	0	31	30	1	314
3	20	$\frac{1}{8}$	38	35	3	421
4	20	$\frac{1}{4}$	33	28	5	374
5	20	1	36	26	10	474
6	20	5	40	4	36	630

The above experiments show the infectious nature of the disease and that it may be greatly reduced by the application of lime to the soil. The author considers an application of about 700 lbs. of finely ground lime equal to an application of 5 tons per acre applied in the usual way. The relative cost and the comparative value of quick and slaked lime are to be subjects for further investigation.

Attacks of Phoma on growing roots, E. ROSTRUP (*Ztschr. Pflanzenkrank., 4 (1894), No. 6, pp. 322, 323*).—The author describes 2 species of *Phoma* that attack root crops of Denmark. The first attacks the

kohl rabi and to it the name *Phoma napobrassicæ* has been given. The other, which has been described by the author as *P. sphærosperma*, attacks beet roots. As this name had been preoccupied, the name now given it is *Phoma betæ*. It is thought by the author that this *Phoma* is genetically related to *Sporidesmium putrefaciens*.

Rust in wheat (*Proc. Rust in Wheat Conf., Brisbane, Queensland, 1894, March, pp. 77*).—Progress reports were given by various committees, and the consensus of opinion seems to be that more attention should be paid to the harder wheats, especially those having narrow leaf blades and which are to a considerable degree glaucous, as the most promising rust resistant varieties. Lists are given of what are considered the more resistant varieties, but they vary in different parts of the country represented. Numerous experiments were reported of the ineffectual use of fungicides on the seed before sown. The report concludes with illustrated descriptions of 45 of the more prominent varieties of wheat.

Treatment for sooty mold of the orange, H. J. WEBBER (*U. S. Dept. Agr., Division of Vegetable Pathology Circular 15, pp. 4*).—The sooty mold of the orange, considered by the author as probably due to *Meliola* spp., produces a very marked effect on the tree and fruit. The leaves and fruit are covered by a black soot-like membrane which greatly hinders the processes of assimilation, and the fruit when ripe is small, insipid, and of a very inferior character. In severe cases the trees fail to produce any fruit.

Experiments show that resin washes are very effective remedies in preventing this disease. The formula recommended is resin 20 lbs., caustic soda $4\frac{1}{2}$ lbs., crude fish oil 3 pt., water to make 15 gal. Place the materials in a large kettle with 13 gal. of water and boil until the resin is dissolved, then add water to make 15 gal. This is a stock solution. When used it must be diluted to 150 gal., and will cost about 45 cts. for such an amount. When too strong the wash will burn the fruit, but in the strength here given no injury will follow. The author states that the disease is only serious in its attack when accompanying the white fly or mealy wing, *Aleyrodes citri*. In badly affected groves 3 periods of application must be observed. Beginning the middle of January, 3 applications should be given at intervals of 2 weeks. In May and June is a second period when the trees should be sprayed, and the third period is in August and September. The spray is easily washed off by rain and should be repeated when a rainfall occurs soon after spraying. Thoroughness of application is required, a 14-year-old tree requiring 15 to 20 gal. for each application.

Treatment for potato rot, A. SEMPOLOWSKI (*Ztschr. Pflanzenkrank., (1894), No. 6, pp. 323–325*).—The author conducted experiments on 10 plats of about $\frac{1}{40}$ acre each for the prevention of potato rot. Plats 1, 4, 7, and 10 were untreated, No. 2 was sprayed with a Bordeaux mixture

containing 6 per cent copper sulphate and 6 per cent fresh lime; No. 3 was sprayed with a 6 per cent solution of iron sulphate and lime; No. 5 was sprayed with an 8 per cent Bordeaux mixture; No. 6 was sprayed with an 8 per cent solution of iron sulphate and lime; No. 8 was sprayed twice, first with a 4 per cent Bordeaux mixture, and 2 weeks later with a 6 per cent solution of the same; No. 9 was treated in the same way, iron sulphate being substituted for the copper sulphate.

The potatoes were planted April 19 and made their appearance above ground June 7. The spraying was done June 28, and when a second was given it was applied July 12. The potatoes were harvested September 5. The highest yield as well as per cent of starch was found in plat 2, while the number of diseased tubers was small. The smallest yield was from plats 6 and 9, the strong solutions of iron sulphate having injured the plants, its effect being plainly seen in the brownish color of the leaves 6 days after spraying. Plats 8 and 9 showed the lowest per cent of diseased tubers. The most rotten tubers were found in the unsprayed rows. However, the yield and starch content of each of these plats exceeded those of the treated ones with the exception of plat 2. The author establishes the fact that iron sulphate injuriously affects the growth of the leaves as well as lessens the yield of tubers. A comparative test of 2 per cent solutions of Bordeaux mixture and iron sulphate and lime solution is to be undertaken.

Potato scab, S. B. GREEN (*Minnesota Sta. Rpt. 1893, pp. 222–228*).—Reprinted from Bulletin 32 of the station (E. S. R., 6, p. 57).

Late blight and rot of the potato, S. B. GREEN (*Minnesota Sta. Rpt. 1893, pp. 215–221*).—Reprint from Bulletin 32 of the station (E. S. R., 6, p. 57).

A new barley smut, H. BIEDENKOPF (*Ztschr. Pflanzenkrank., 4 (1894), No. 6, pp. 321, 322*).—The author describes as *Ustilago medians* a new species of smut of barley that from cultures seems to be intermediate in its characters between *U. hordei* and *U. jensenii*. A more critical study of the species is to follow.

List of parasitic plants found near the station, O. LUGGER (*Minnesota Sta. Rpt. 1893, pp. 307–312*).—A list of fungi, embracing about 150 species, is given, arranged in the order of their hosts. The more numerous genera represented are as follows: *Peronospora*, 7 species; *Puccinia*, 18 species; *Cercospora*, 10 species, and *Septoria*, 11 species. There are 35 orders of phanerogams represented in the list of hosts.

New species of fungi, J. B. ELLIS and B. M. EVERHART (*Proc. Phil. Acad. Sci., 1894, III, pp. 322–386*).—Descriptions and critical notes on new species.

Diseases of the vine (Cont.), G. MASSEE (*Gard. Chron., 17 (1895), ser. 3, p. 134*).—A brief description of anthracnose (*Sphaceloma ampelinum*) is given. Dusting plants with equal parts of sulphur and lime is advised. Too free use of fresh stable manure is thought to favor the development of the disease.

Chytridiose of the grape and its treatment, A. PRUNET (*Prog. Agr. et Vit., 12 (1895), No. 3, pp. 73–76; No. 4, pp. 91–98*).

Sulphuric acid for grape anthracnose, L. DEGRULLY (*Prog. Agr. et Vit., 12 (1895), No. 6, pp. 135, 136*).—Ten liters of sulphuric acid to 100 of water gave good results when applied to grapes, equaling the acid iron sulphate solution without the trouble and expense of the copperas.

Report on experiments with "Fostite", 1894, W. M. SCHÖYEN (*Tidskr. norske Landbr., 1 (1894), pp. 441–443*).—The Fostite (90 per cent magnesium silicate, 10 per cent copper sulphate) was applied with some degree of success against fungus diseases of potatoes and other crops.

Observations on the application of fungicides and insecticides (*New York State Sta. Bul. 74, pp. 383–405, figs. 12*).—Illustrations and descriptions are given of various kinds of apparatus for the application of fungicides and insecticides, together with formulas for Bordeaux mixture, kerosene emulsion, and Paris green solutions.

ENTOMOLOGY.

Insect Life (*U. S. Dept. Agr., Division of Entomology, Insect Life, vol. VII, No. 3, pp. 217–280, figs. 10*).—*Special notes* (pp. 217–219).—Under this head are treated the need of quarantine laws in the East, the double-broodedness of the codling moth, the chinch bug in 1894, and reviews of entomological publications.

Damage by the American locust, L. O. Howard (pp. 220–229).—An account of a destructive invasion of *Schistocera americana* in Roanoke County, Virginia, where oats, clover, corn, fruit trees, and other vegetation were defoliated by the insects. Illustrated, descriptive, and life history notes are given and a detailed report upon the attack, by D. W. Coquillett, is included. A mixture of bran, arsenic, and sugar distributed through the fields proved an efficient means of destruction.

Chinch bug observations in Iowa in 1894, H. Osborn (pp. 230–232).—Notes on devastations by this insect—wheat, barley, rye, oats, and corn suffering in the order given. The bugs were found in the vast majority of cases to have hibernated in osage orange hedges. Light, friable soils were most infested.

The hibernation of the chinch bug, C. L. Marlatt (pp. 232–234).—Notes and observations on this point of the life history, the normal hibernating place of the chinch bug being believed to be the dense stools of certain wild grasses, which it is recommended be burned in the winter. The life cycle of the insect for central Kansas is summarized.

A maple pseudococcus, L. O. Howard (pp. 235–240).—Illustrated, descriptive, and life history notes on *Pseudococcus aceris*, a rare scale which occurred on maples in 4 or 5 localities in the northern United States the past season.

Notes on cotton insects found in Mississippi, W. H. Ashmead (pp. 240–247).—A continuation of a paper begun in Insect Life, vol. VII, No. 1 (E. S. R., 6, p. 563). This installment contains an annotated list of the Hymenoptera and Coleoptera found in cotton fields by the writer. The following new genus and species are described: *Chrysopophagus*, *C. compressicornis*, *Zachresta dimidiata*, *Limneria mississippiensis*, *Lymeon annulicornis*, *Otacustes atriceps*, and *O. chrysopæ*.

The codling moth double-brooded, C. L. Marlatt (pp. 248–251).—An exhaustive review of the data bearing on this point, with the conclusion that in the greater part of the United States the insect has 2 annual broods, though in the northern States there is but 1, and there are 3 in California.

A new sawfly, which is injurious to hollyhocks, T. D. A. Cockerell (pp. 251–253).—A technical description of *Nematoneura malvacearum*.

Notes on Hylesinus sericeus, E. A. Schwarz (pp. 254–256).—Notes on the habits of this scolytid infesting Engelmann's spruce (*Picea engelmanni*) in the Wahsatch Mountains, Utah. An illustration is given of the workings under the bark.

A new parasite of Mytilaspis pomorum, L. O. Howard (p. 256).—Technical description of *Chiloneurus diaspidinarum*, a hymenopterous parasite of the apple oyster-shell bark louse.

The patent on the hydrocyanic acid gas process declared invalid, D. W. Coquillett (pp. 257, 258).—Note on a recent court judgment on this point in California.

A new pear insect (pp. 258–260).—Notes on *Agrilus sinuatus*, a flat-headed borer imported from Europe, that has caused considerable damage to pear trees in New Jersey.

Scorpions, centipedes, and tarantulas (pp. 260–263).—Notes on the venom of these animals, with letters from 2 entomologists who had been stung by scorpions in the Tropics.

General notes, and notes from correspondence (pp. 263–280).—Among these may be noted the following: Grain insects in mills, the carnation twitter again, legislation against insects in British Columbia, a new department of the Pasteur Institute, some South Australian matters, coöperative work against insects, a New Zealand moth-catching plant, the army worm in 1894, abundance of *Charæas graminis* in Scotland, two more important Vedalias, damage by the brown sap chafer, abundance of an imported snout beetle in Maine, damage to clover in Michigan, a new cotton insect in Texas, the pear midge in England, destructive grasshoppers in New York, an important scale insect on cottonwood, the spider which bites, cicada chimneys, bird lice as mutualists, occurrence of the pear-leaf blister mite upon the Pacific Coast, maggots in poor butter, new habitats for the Florida red scale, the potato-scab gnat in Missouri, Oklahoma food of the harlequin cabbage bug, the apple maggot in North Carolina, the sugar-cane weevil in the Fiji Islands, horn fly on horses again, the barnacle scale in Louisiana, and the hen flea on horses.

Report of the entomologist, F. L. HARVEY (*Maine Sta. Rpt. 1893, pp. 146–151, 159–180, figs. 16*).—Illustrated, descriptive, life history, and remedial notes on the Angoumois grain moth (*Gelechia cerealella*), lime-tree winter moth (*Hybernia tillaria*), apple-leaf bucculatrix (*Bucculatrix pomifoliella*), disippus butterfly (*Limenitis disippus*), May beetle (*Lachnosterna fusca*), bean weevil (*Bruchus obtectus*), pear-blight beetle or shot-borer (*Xyleborus pyri*), and carrot fly (*Psila rosæ*).

The apple-leaf bucculatrix was observed damaging apple trees in the State for the first time, and its habits were especially investigated. The damage was done in early summer and it is believed that there is but one brood in Maine. Jarring the larvæ from the trees, spraying with kerosene emulsion in the winter and when the larvæ hatch, and hand picking the cocoons are recommended. Kainit, kerosene

emulsion, and turning hogs in infested fields are suggested against the larvæ of the May beetle. The bean weevil was quite injurious, and it is suggested that infested seeds be thrown into hot water for a few minutes or heated to 145° F. for an hour. Bisulphid of carbon is also suggested. The pear-blight beetle was noticed for the first time attacking fruit trees, it having previously been noticed only on forest trees. It is recommended that blighted twigs or limbs be cut off promptly and burned. The larvæ of the carrot fly were found burrowing in barrels of carrots. Treating the infested roots with hot water is advised. Pouring kerosene emulsion along the rows of plants during the growing season it is thought may be advantageous.

Gas treatment for destroying scale insects on citrus trees, A. CRAW (*California State Bd. Hort. Rpt. 1893 and 1894, pp. 105-109, pls. 2*).—Directions for the preparation of hydrocyanic acid gas and its application, the manufacture of the tents and other apparatus being detailed. It is advised that the tents be treated with a light coat of linseed oil, or, better, with a watery extract of the common prickly pear cactus (*Opuntia engelmani*) combined with glue and ocher or Venetian red.

Experiments were made in spraying apple trees with a solution of Paris green and Bordeaux mixture as a combination remedy against codling moth and apple scab.

Beneficial insects, A. CRAW (*California State Bd. Hort. Rpt. 1893 and 1894, pp. 96–105, pls. 3*).—Descriptive notes and colored illustrations of the following insects, native and imported, preying upon various scale insects: Two-spotted ladybird (*Adalia bipunctata*), *Anatis subvittata*, twice-stabbed ladybird (*Chilocorus bivulnerus*), ashy-gray ladybird (*Coccinella abdominalis*), California ladybird (*C. californica*), 22-spotted leis (*C. (Leis) conformis*), eyed ladybird (*C. oculata*), blood-red ladybird (*C. sanguinea*), Julian's banded ladybird (*C. trifasciata juliana*), Pilate's ladybird (*Exochomus pilatei*), convergent ladybird (*Hippodamia convergens*), ambiguous ladybird (*H. ambigua*), *Hyperaspis lateralis*, striped ladybird (*Megilla vittigera*), Koebele's ladybird (*Novius koebelei*), six-spotted orcus (*Orcus australasia*), steel-blue ladybird (*O. chalybeus*), 20-spotted ladybird (*Psyllobora 20-maculata*), brown-necked ladybird (*Rhizobius toowoombæ*), black ladybird (*R. ventralis*), Australian ladybird (*Vedalia cardinalis*), a lepidopterous enemy of the black scale (*Thalpochares coccophaga*), lace-winged fly (*Chrysopa californica*), brown lace-winged fly (*Hemerobius*), spine-legged soldier bug (*Sinea spinipes*), gray soldier bug (*Euschistus tristigmus*), and syrphus fly (*Catabomba pyrastri*).

Entomology and quarantine, A. CRAW (*California State Bd. Hort. Rpt. 1893 and 1894, pp. 79–90, figs. 3*).—A report of the inspection of steamers and their cargoes to avoid the introduction of injurious insects. Details of the work of fumigation are given. Notes are included on some of the beneficial insects of the State, chiefly lady-

birds, and on some of the injurious insects and their parasites. Descriptive and remedial notes are given.

The silk industry, FRY and JAMES (*Agl. Gaz. N. S. W., 5 (1894), No. 11, pp. 812–817*).—A general article to show that the industry could flourish in Australia.

Note on Pulex pallidus and Sarcopsylla gallinacea, from Transcaspia, J. WAGNER (*Hor. Soc. Ent. Ross., 28 (1894), No. 3 and 4, pp. 440–443*).—Gives description and figures of the chicken flea from specimens found on owls in Middle Asia. The species is identical with that occurring in Florida.

On a new species of Ixodidæ from Congo, J. MARTIN (*Ann. Sci. Nat., 18 (1894), 2d ser., pp. 267–277, pl. 1*).—This contains a description of *Amblyomma quantini* and a partial bibliography of *Ixodidæ*.

Furniture beetles, S. L. MOSLEY (*The Naturalists' Journal, 4 (1895), No. 31, pp. 14, 15*).—Ravages of *Anobium domesticum, Xertobium tesselatum,* and *Ptilinus pectinicornis* in the wood of furniture, etc. Paraffin is recommended as a remedy.

Scale insects, A. CRAW (*California State Bd. Hort. Rpt. 1893 and 1894, pp. 90–96, figs. 8*).—Descriptive and life history notes on an elm scale (*Gossyparia ulmi*), depressed scale (*Lecanium depressum*), pine tree scale (*L. insignicolla*), black scale (*L. oleæ*), orange chionaspis (*Chionaspis citri*), long scale (*Mytilaspis gloverii*), and purple scale (*M. citricola*). Against the elm scale a resin wash is recommended in the winter and kerosene emulsion in the spring and summer. Formulas are given for the preparation of these insecticides.

Observations on Physapoda in the summer of 1893, F. TRYBORN (*Ent. Tidskr., 15 (1894), No. 1 and 2, p. 41*).

The red gooseberry mite (Bryobia nobilis), F. THOMAS (*Whittmark's Gartenflora, 43 (1894), pp. 488–490*).

Injury to gooseberry plants by Bryobia ribis, F. THOMAS (*Mitt. Thür. Bot. Ver., 2d ser., 6 (1894), pp. 10, 11*).

The oviposition of Melitara prodenialis, H. G. HUBBARD (*Proc. Ent. Soc. Wash., 3 (1895), No. 3, pp. 129–132*).—Description and figure of the peculiar mode of oviposition of this moth, which is greatly destructive to cultivated cacti.

Treatment of vines infested with phylloxera with mulches of peat impregnated with schists, F. DE MÉLY (*Compt. Rend., 120 (1895), No. 2, pp. 67–69*).

Legislation against plant pests, C. S. SARGENT (*Garden and Forest, 8 (1895), No. 362, pp. 40, 41*).

"Insect Lime," J. B. SMITH (*Ent. News, 1895, Feb., pp. 46, 47*).—Recommends it for protecting fruit trees.

On an Acarien parasite of Lampyris splendidula, A. GRUVEL (*Compt. Rend., 120 (1895), No. 3, pp. 161, 162*).

The use of parasitic and predaceous insects, C. M. WEED (*Amer. Nat., 29 (1895), No. 337, pp. 69, 70*).

Rhizobius ventralis, B. M. LELONG (*California State Bd. Hort. Rpt. 1893 and 1894, pp. 426–432*).—An article on the introduction of the black ladybird. Extracts from letters of horticulturists in various parts of the State are included, testifying to the value of the ladybird in destroying the black scale.

Beneficial insects, A. KOEBELE (*California State Bd. Hort. Rpt. 1893 and 1894, pp. 145–150*).—General notes on some of the natural parasites of coccids injurious to fruit trees in Australia, with notes on their habits, some of the scale insects, and the condition of fruit growing in that country.

Report of the government entomologist of Sweden for the year 1893, S. LAMPA (*Ent. Tidskr., 15 (1894), No. 1 and 2, pp. 1–40*).

The classification of insects and their relation to agriculture, O. LUGGER (*Minnesota Sta. Rpt. 1893, pp. 75–143, figs. 81*).—A reprint of Bulletin 28 of the station (E. S. R., 4, p. 932).

On economic entomology and mycology in the United States and what we can learn therefrom, M. HOLLRUNG (*Jahrb. deut. landw. Ges., 9 (1894), pp. 60–70*).

FOODS—ANIMAL PRODUCTION.

Analyses of cattle foods, W. H. JORDAN, J. M. BARTLETT, and L. H. MERRILL (*Maine Sta. Rpt. 1893, pp. 25–36*).—This includes studies on the composition of corn fodder and silage from different varieties, the comparative composition of large Southern corn and the smaller Maine field corn, the influence of maturity upon the composition of the corn plant, the constituents of the nitrogen-free extract, and the effect of slow drying upon a sample of a succulent plant (p. 744).

Observations have been made for 5 years on the composition of large Southern corn and of the smaller native corn grown in Maine. The latter matures, but the former has to be cut when immature. The average composition of the dry matter of the 2 varieties is given as follows:

Composition of the dry matter of 2 varieties of corn.

Average for 1892 and 1893.	In 100 parts water-free substance.				
	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.
Southern corn, immature	7.76	11.72	27.70	50.54	2.28
Maine field corn, mature	6.05	10.94	19.79	60.33	2.89
Differences	+.71	+.78	+7.91	—9.89	—.61

"The Maine field corn, which reaches maturity, contains the larger percentage of dry matter. . . .

"The dry substance of the larger and immature corn contains more ash, protein, and fiber and less nitrogen-free extract and fat. The much larger percentage of fiber and greatly less percentage of nitrogen-free extract are the noteworthy differences."

The Maine field corn was cut at 5 different dates from August 15 to September 21 and samples of each cutting analyzed. These analyses show that as the corn approaches maturity there is a continuous and large increase in the percentage of dry matter, due principally to an increase in nitrogen-free extract. To determine if possible what components were responsible for this increase in nitrogen-free extract determinations were made of the starch by means of diastase and the acid method and of the sugar. These showed "that while a decrease in sugar occurred with the maturing of the ear, this was much less than the corresponding increase of starch, so that maturity shows a large excess over any other period of the more valuable carbohydrates."

A comparison of the starch and sugar in immature Southern corn and mature native corn, both grown in Maine, showed the following:

Sugars and starch in the immature and mature corn plant.

	Parts in 100 of water-free substance.				Parts of sugars and starch in 100 parts of nitrogen-free extract.
	Sugars.	Starch.	Total sugars and starch.	Total nitrogen-free extract.	
Southern corn, immature, no ears, 4 samples	12.85	1.07	13.92	50.55	27.5
Maine field corn, mature, full ears, 4 samples	13.32	14.02	27.34	60.33	45.3
Excess in the Maine field corn	0.47	12.95	13.42	9.78	17.8

"There is a constant and striking difference between the percentages of starch in the Southern corn and in the Maine field corn. They are much larger in the latter kind. This is due undoubtedly to greater maturity. Only a small amount of starch appears to be deposited in the stalk and leaves, its rapid formation and storage in the plant apparently not beginning until the later development of the fruit or kernels."

The digestibility of the pentose carbohydrates, W. E. STONE and W. J. JONES (*Maine Sta. Rpt. 1893, pp. 44–56*).—This is a reprinted article,[1] and relates to the study of the pentose carbohydrates in a large number of feeding stuffs fed in digestion trials at the Maine Station and in the feces from the same.

"The grasses make the largest showing, but in the majority of samples the pentosans amounted to from 20 to 30 per cent of the non-nitrogenous extractive matter. . . .

"The data for the pentosans in feces of sheep, excluding the data for *Calamagrostis canadensis*, which evidently present something anomalous, shows 58.2 per cent of pentosans to have been digested and 41.8 per cent undigested.

"These results are worthy of consideration. Twenty of the best known food stuffs for cattle are here shown to contain a minimum of from 6 to 16 per cent of their dry weight in pentosans, of which an average of only 58.2 per cent is found to be digestible. It appears, then, that while these bodies are to be for the present classified among the carbohydrates, they are really much less digestible, and hence of less food value, than the better known members of this group, such as starch, sugar, etc. In many cases the indicated digestibility is even less than that assigned to the fiber of the same materials, and the average of all the experiments is but little higher than the corresponding average for the fiber."

Effect of slow drying upon a sample of a succulent plant, W. H. JORDAN, J. M. BARTLETT, and L. H. MERRILL (*Maine Sta. Rpt. 1893, pp. 35, 36*).—A sample of about 500 lbs. of field corn was chopped fine and spread out on a scaffold to dry, and a subsample was taken and dried rapidly in a steam closet in the laboratory. Analyses of the rapidly and slowly dried samples are given.

"It seems that for each 100 lbs. of green corn 3.58 per cent of dry matter was lost in the process of slow drying under the most favorable circumstances. This was 14.13 per cent of the total dry matter in the fresh plant, which means that of each 100 lbs. of dry substance originally in the plant only 85.87 lbs. were saved.

[1] Agl. Sci., 7 (1893), No. 1, p. 6.

"It is interesting to note that this loss falls almost entirely on the nitrogen-free extract, or carbohydrates, more than two thirds of it being actually accounted for by the diminished percentage of sugars."

Effect of watering, whether before or after eating or ad libitum, on digestibility of the food and nitrogen exchange, S. GABRIEL and H. WEISKE (*Landw. Vers. Stat., 45, No. 3 and 4, pp. 311–323*).—To determine whether it was immaterial when animals were watered, as shown by the amount of water taken, the utilization of the food, and the nitrogen exchange of the body, a trial was made with 2 grown sheep, lasting from June 2 to 29, divided into 3 periods. In the first period water was kept before the sheep all the time; in the second No. 1 was watered before feeding and No. 2 after; and in the third the order was reversed. The food consisted uniformly of 800 gm. of meadow hay and 250 gm. of whole oats per sheep daily, fed in 3 portions. The quantity of water drunk and the amount and composition of the solid and liquid excreta were determined for each sheep in each period. The average results follow:

Average water consumption, nitrogen exchange, and nitrogen storage per sheep daily.

Manner of watering.	Amount of water drunk.		Nitrogen exchange of body.[1]		Nitrogen stored in body.	
	No. 1.	No. 2.	No. 1.	No. 2.	No. 1.	No. 2.
	Cc.	*Cc.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Ad libitum	1,804	2,333	7.34	8.21	1.59	1.22
Before feeding	1,596	1,765	7.88	8.18	1.00	1.30
After feeding	1,870	2,127	7.89	8.26	1.27	1.38

[1] As shown by nitrogen in urine.

Digestibility of ration under different methods of watering.

Manner of watering.	Protein.		Fat.		Fiber.		Nitrogen-free extract.	
	No. 1.	No. 2.	No. 1.	No. 2.	No. 1.	No. 2.	No. 1.	No. 2.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Ad libitum	57.37	60.55	63.59	65.96	61.73	53.48	66.78	68.52
Before feeding	57.04	60.89	65.98	66.88	52.90	60.26	66.14	64.17
After feeding	58.85	61.94	64.33	66.33	57.89	59.54	65.44	67.15

It will be seen that sheep No. 1 invariably drank more water than sheep No. 2, which is believed to be a matter of individuality. Both sheep drank less water when it was given before feeding than when given *ad libitum* or after feeding. The average difference amounted to 13 per cent with No. 1 and 21 per cent with No. 2. There was no apparent connection between the manner of watering and the nitrogen exchange, although this was somewhat greater throughout in the case of No. 2, due, it is suggested, to the greater water consumption. Likewise in the rate of digestibility there were no regular differences that could be attributed to manner of watering.

The conclusion is reached that under the conditions here prevailing there is no difference in the rate of digestibility of the food, production, etc., whether the animals are given water *ad libitum* or before or after eating.

Digestion experiments, W. H. JORDAN (*Maine Sta. Rpt. 1893, pp. 38–43*).—The results are given of digestion trials with sheep on Southern corn fodder, field corn fodder, sweet corn fodder, Southern corn silage, and field corn silage. No data are given except the composition of the materials as fed and the digestion coefficients found. The latter were as follows:

Digestion coefficients of corn fodder and corn silage.

	Dry matter.	Organic matter.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.
Southern corn fodder, 1891	61.3	62.8	43.1	63.4	65.7	61.0	59.0
Field corn fodder, 1891	72.7	74.2	50.7	67.6	78.6	73.8	64.7
Sweet corn fodder, 1891	70.9	72.7	44.0	71.5	74.6	73.1	77.0
Southern corn silage, 1892	64.4	65.8	48.2	64.8	66.7	65.4	67.8
Field corn silage, 1892	78.0	80.2	41.3	68.0	77.9	83.1	80.9
Do	76.0	77.9	36.6	73.3	77.8	78.5	80.9
Field corn fodder, 1893	69.8	71.4	54.5	70.4	72.3	71.3	67.3
Do	69.7	73.6	20.0	68.6	70.7	76.7	73.7

During the past 4 years 37 digestion trials have been made at the station on corn fodder and corn silage. The results of these are compared with the digestion coefficients for timothy hay, wheat bran, and corn meal.

"These figures show beyond question that corn fodder well preserved and corn silage have a high digestibility as compared with hay. To this fact should be attributed in large measure undoubtedly the great favor with which the corn plant, as now preserved in the silo is regarded by dairymen as milk-producing food. What has been supposed by many to be due to the peculiar influence of the fermentations in the silo, should more properly be credited to the superior food properties of the plant which the silo conserves so efficiently, and which would be equally valuable when preserved as completely in any other manner."

A comparison is also made of the digestibility of the fodder and silage from native field corn and from Southern corn grown in Maine. The comparison is as follows:

Comparative digestibility of 2 varieties of corn grown under similar conditions.

	Dry matter.	Organic matter.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.
Field corn fodder and silage, 7 samples, 17 trials	72.3	74.6	36.8	65.1	76.5	75.5	74.9
Southern corn fodder and silage, 5 samples, 12 trials	64.6	66.5	39.7	59.6	71.0	65.2	66.3
Difference in favor of the field corn	7.7	8.1	....	5.5	5.5	10.3	8.6

"It is certainly a matter of some importance to Maine farmers that the smaller variety of corn, which matures in this latitude, should prove to be more digestible to the extent of about 8 per cent of the total dry matter.

"The nitrogen-free extract appears to show a greater difference of digestibility than other portions of the plant, and it is here that we must look for at least a partial explanation of the fact under discussion. . . .

"Several examinations of the feces in these experiments have failed to show the presence of sugars or starch, the diastase test being employed for the latter. These carbohydrates being entirely soluble in the digestive fluids, as it was reasonable to expect, their presence in these foods in greatly varying quantities must certainly cause corresponding variations in the digestibility of the nitrogen-free extract, and consequently of the total dry matter, other things being equal. That this is so is easily seen from the figures presented."

Steer feeding, A. A. MILLS (*Utah Sta. Bul. 35, pp. 23*).—Three lots of 4 steers each were fed alike on mixed hay from November 29 to December 20. From then until April 11 lot 7 had mixed hay alone; lot 8, hay with straw, alfalfa, or clover, and 3 lbs. grain per head for 1 month; and lot 9 had hay and 3 lbs. grain (bran, wheat, and barley) per head daily. In the finishing period, April 11 to May 16, all received alike 3 lbs. of grain (bran and wheat) per head, 10 lbs. roots, 3 lbs. straw, and hay *ad libitum.*

The steers were kept in yards with open sheds. The gains in weight, food eaten, and financial results are tabulated. From November 29 to April 11, lot 7 (mixed hay) gained 574 lbs. in all; lot 8, 270 lbs., and lot 9 (hay and grain), 252 lbs. During the final period lot 7 gained 39 lbs.; lot 8, 11 lbs., and lot 9, 91 lbs. For the whole trial the average cost of food per pound of gain was 7.2 cts. for lot 7, 10.71 cts. for lot 8, and 8.51 cts. for lot 9. With steers at 2½ cents per pound there was a loss with all the steers, which was least with lot 9.

Steers fed moderately well for 12 weeks.—Six lots of 3 steers each which had been used in an experiment with alfalfa, reported in Bulletin 31 of the station (E. S. R., 6, p. 203), were fed from February 21 to May 16 variously on hay with silage, roots, or straw, and 4 lbs. of grain per head daily; or hay and roots with 4, 6, or 8 lbs. of grain. The grain was a mixture of bran, barley, and wheat. The coarse fodder was fed *ad libitum.* The gains, food eaten, and financial results are tabulated.

"Of the 3 sets of steers fed either roots, silage, or straw as an appetizer, those fed the roots gained most, with straw second and silage third.

"Of steers fed 4, 6, and 8 lbs. of grain per day, respectively, the gain increased as the amount of grain fed was increased; the cost of the daily ration increased likewise; while the cost of 1 lb. of gain decreased as the amount of grain fed increased."

Feeding experiments with cows, W. H. JORDAN (*Maine Sta. Rpt. 1893, pp. 66–82*).—*Relative feeding value of Southern corn silage and Maine field corn silage* (pp. 66–73).—The object of this experiment was to compare silage from native Maine corn and from large Southern corn grown in Maine. Five cows were fed in 3 periods of about 1 month each. In the first and last periods about 40 lbs. of Southern corn silage was fed per day, and in the second period about 30 lbs. of native corn silage. The other foods consisted of corn meal, bran, gluten meal, and cotton-seed meal, with barley hay in the first 2 periods and timothy hay in the last. The digestible food material in

the daily ration of the 3 periods was 14.23, 16, and 14 lbs., respectively. The analyses of the feeding stuffs given, the amount of nutrients consumed, weight of cows, and the yield and composition of the milk are tabulated.

"The cows lost from 15 to 30 lbs. weight in passing from the first to the second periods, and this loss was partially regained during the third period. These changes in live weight can be readily explained by the less weight of silage eaten in the second period, with no marked change in the quantity of water drank in any period. . . .

"When we see that in the second period of this experiment practically the same weight of milk was produced, and that owing to an increase in the dry matter of the milk there was actually a larger production of milk solids, we have good presumptive evidence that the ration containing the 30 lbs. of [native] field corn silage was more efficient than the previous ration containing 40 lbs. of Southern corn silage. This evidence is strengthened by the fact that when in the third period a return is made to the Southern corn silage the yield of milk solids is decidedly diminished.

"[The indications are] that, pound for pound, the Maine field corn silage was worth more than the Southern corn silage, and that the difference was practically in the proportion of the amount of digestible dry substance in the 2 materials. This is the result which a careful consideration of the facts learned in other ways would lead us to expect."

The influence of widely differing rations upon the quantity and quality of milk (pp. 73–82).—An experiment is reported with 3 cows, covering 3 periods of 35 days each, in which the following rations were compared:

Ration 1:
- Timothy hay .... *ad lib.*
- Corn meal .... 2 pounds.
- Cotton-seed meal .... 2 pounds.
- Gluten meal .... 2 pounds.

Ration 2:
- Timothy hay .... *ad lib.*
- Corn meal .... 6 pounds.

Cow A received ration 1 during the first and third periods and ration 2 during the second period, and cows R and L T received ration 2 during the first and third periods and ration 1 during the second period. The nutritive ratio of ration 1 was 1 to 6.7, and of ration 2, 1 to 12.3. Both rations furnished practically the same amount of digestible material. The amounts of food eaten and the yield and composition of the milk, melting point, volatile acids, and iodin equivalent of the butter are tabulated for each cow. The yield of milk and of milk solids was as follows:

Yield of milk and milk solids on nitrogenous and carbonaceous rations.

	Daily yield of milk.			Daily yield of milk solids.		
	Nitrogenous ration.	Corn-meal ration.	Excess with nitrogenous ration.	Nitrogenous ration.	Corn-meal ration.	Excess with nitrogenous ration.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Cow A	25.6	20.0	5.6	3.61	2.68	0.93
Cow R	20.7	15.2	5.5	2.88	2.07	0.81
Cow L T	19.1	15.6	3.5	2.72	2.10	0.62

"The cows did not vary greatly in body weight, but their general appearance showed less thrift while being fed the corn-meal ration.

"The yield of milk from the nitrogenous ration was from one fifth to more than one third larger than that from the corn-meal ration, the excess ranging with the 3 cows from 20 per cent to 36 per cent, or an average of about 5 lbs. of milk per day.

"In general the milk was materially richer while the cows were fed the ration rich in protein, though with one cow it showed the largest percentage of solids during the third period while she was eating the corn-meal ration. With the other two cows the influence of the mixture of cotton-seed meal, gluten meal, and corn meal in increasing the per cent of solids of the milk seemed quite marked.

"The daily yield of milk solids was from 30 to 40 per cent greater with the more nitrogenous ration.

"The composition of the milk solids seemed to be independent of the ration. In general the proportion of fat increased throughout the experiment without regard to what the cows were fed, and no evidence is furnished in support of the notion that by changing the food it is possible to produce more butter fat without an accompanying increased production of the other milk solids. In other words, it appears that the most profitable food for butter production will also be most profitable for the milk farmer or cheese maker. The relation of fat to the other solids seems to be determined by the animal or by certain unknown conditions of environment rather than by the food.

"So far as could be learned by chemical tests, the butter made from the 2 rations was not greatly different."

Dairy herd record for 1892, T. L. HAECKER (*Minnesota Sta. Rpt. 1893, pp. 313–324*).—A record for the year of 27 cows, including Jerseys, Guernseys, Holsteins, Polled Anguses, Shorthorns, and grades. This shows for each cow the date of calving, change in weight, monthly yield and composition of milk, and monthly and yearly yields of butter.

"The fat for the entire herd ranged from an annual average of 3.34 to 6 per cent. This marked difference is clearly a breed characteristic. . . .

"While there is a general tendency for the milk to grow richer in fat as the period of lactation advances, this change is not as great or as uniform as is generally supposed. [The individual records for January, March, June, and July show that] in January the daily average in milk of the 17 cows amounted to 423 lbs.; in March it shrunk to 354.3 lbs.; while in June, when the cows were in pasture, it increased to 375 lbs., and in July, when pastures began to be dry, there was again a shrinkage to 301.6 lbs., showing that the succulent food in June materially increased the flow of milk. In January the average per cent of fat in the milk was 4.55, in March it rose to 4.95, and in June it dropped to 4.49; that is, after the expiration of 6 months the average per cent of fat was less by 0.06 per cent, showing that feed exercised a greater influence in the per cent of fat than did the advanced period of lactation. The fact that the per cent of fat in July, when the Kentucky blue grass, of which the pasture was composed, was dry, rose to 4.81, gives additional evidence that the variation in the fat was largely due to feed influences. . .

"[The butter fat record] shows a gradual decrease in the amount of fat, as the period of lactation advances, and also shows that this shrinkage takes place very slowly and gradually when cows are of the proper dairy breeding type. . . .

"Comparing the annual butter yield with the live weight, the registered Jersey, Pride, is in the lead, making 0.46 lb. of butter for every pound of live weight, followed by the grade Jersey, Marie, with 0.44; the grade Guernsey, Olive, 0.44; the grade Jersey, Beckley, with 0.43; then Sweet Briar, Rose, and Rossie, 0.40 lb. each. . . .

"Our best cows, the annual butter product of which exceeds 40 per cent of the live weight, are small or medium in size, though good ones are found among the larger."

Feeding experiments with pigs, W. H. JORDAN (*Maine Sta. Rpt. 1893, pp. 82–95*).—These experiments include comparisons of breeds and a comparison of skim milk, pea meal, and corn meal with a mixture of equal parts of pea meal, oat meal, and corn meal on 3 different breeds of pigs. The relation of the food to growth in different breeds is shown in the following summary:

Relation of food to growth in pigs (digestible organic material for each pound of gain).

Experiment.	Cheshire.	Poland China.	Yorkshire.	White Chester.	Jersey Red.	Berkshire.	Tamworth.	Tamworth-Berkshire.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
1890	2.88	2.73	2.50	2.50	....	2.45	....	....
1891	3.12	....	....	2.78	2.93	....	....	....
1891–'92, early growth	....	....	....	....	....	....	3.18	2.48
1891–'92, later growth	....	....	....	....	....	....	3.71	2.89
1892, period 1	....	....	....	....	....	2.36	2.11	2.03
1892, period 2	....	....	....	....	....	3.80	3.20	3.20
1892, period 3	....	....	....	....	....	5.87	4.03	3.52
1892, period 4	....	....	....	....	....	3.80	4.19	4.02
1892, average 4 periods	....	....	....	....	....	3.40	3.21	3.00

"These experiments furnish no evidence of the superior producing capacity of any one of the breeds tested. . . . It is certainly true of the Tamworth-Berkshire cross that the animals were finely formed and vigorous, and they certainly used food more economically than either the pure bred Tamworths or Berkshires. This cross has been admired by all who have seen it, and the market quality of their carcasses was highly commended.

"[The butcher's analysis of the carcasses] do not warrant the claim that any one of the breeds compared possesses superior market qualities over all the others. The Tamworth's gave a somewhat larger percentage of lean cuts and the Tamworth-Berkshire cross a larger proportion of salting pork. The differences are small, we may believe, compared with those which may be caused by age, food, or individual variations."

In a comparison of the dry matter of skim milk with the digestible matter of pea meal 2 lots of pigs were selected from the same litters and fed rations composed of skim milk, pea meal, and corn meal, or rations in which pea meal or oat meal was made to take the place of skim milk in the proportion of digestible substance in the two. The rations contained practically the same amounts of digestible matter. Tamworths, Berkshires, and Tamworth-Berkshires were represented.

"It is very plain that for young pigs the rations containing skim milk proved superior to those containing the nitrogenous vegetable foods as a substitute. But with the older animals the substitution of pea meal or pea and oat meal for the skim milk, wholly or in part, did not materially change the rate of growth or its relation to the digestible food consumed.

"In a single case an exception occurs, viz: Period 3 with the Berkshires in the 1892 experiment, where the pure grain ration seemed to check the growth of the pigs. In all other cases the amount of digestible food seems to be the practical measure of efficiency, whether its source be animal or vegetable."

Relative value of corn and oats for horses, A. A. MILLS (*Utah Sta. Bul. 36, pp. 12*).—Two teams of work horses were divided into 2 lots, one horse for each team being in each lot. Fifteen pounds of mixed hay and 3 lbs. of wheat or bran per head were given to the horses in both lots, and those in one lot received 6 lbs. of corn, while those in the other lot received 6 lbs. of oats per head. The grain was ground and mixed before feeding. The trial lasted from April 18 to September 26, and the rations were reversed several times during the trial. Grouping the changes in weight according to the kind of feed, "It will be seen that those on the oat ration lost 47 lbs., while those on the corn ration gained 29 lbs., thus favoring the corn ration by a total of 76 lbs. . . . The corn contained 323.77 lbs. more digestible matter than did the oats. This is just about sufficient to account for the excess of gain of the corn-fed lot over the oat-fed."

Reference is made to previous experiments bearing on this subject published in the Annual Report of the station for 1892 and Bulletin 30 (E. S. R., 5, p. 77, and 6, p. 240).

"To sum up the 3 experiments, we find: First, that during the summer corn and timothy were not so good as oats, wheat, and clover in maintaining the weight of horses; second, that during the winter corn and timothy did as well as oats, clover, and timothy in maintaining the weight of horses; third, that during the spring and summer corn, wheat, or bran and mixed hay produced more gain than oats, wheat, or bran and mixed hay."

The effect of different acids on pepsin digestion, M. HAHN (*Virchow's Arch. path. Anat. und Physiol., 137, pp. 597–604; abs. in Chem. Centbl., 1894, II, No. 14, p. 618*).—The effect of sulphuric, nitric, phosphoric, boracic, oxalic, citric, and tartaric acids was compared with that of hydrochloric acid, in a 0.281 per cent digestive solution, on the following substances: (1) Albumen solution, prepared by neutralizing egg albumen with dilute hydrochloric acid; (2) moistened fibrin; (3) dry fibrin; and (4) coagulated egg albumen.

The results showed that the acids employed had different effects, but that the hydrochloric acid was the most advantageous in the digestion of albuminoids. The organic acids taken as a whole were less effective in digestion than the inorganic acids. Only in the case of fibrin were tartaric and oxalic acids of value. The order of effectiveness of the mineral acids on albumen solution was hydrochloric acid, nitric acid, sulphuric acid, and phosphoric acid. When moistened fibrin was used phosphoric acid stood at the head. The boracic acid was of no value to digestion, which was to be expected. It gives insoluble precipitates with most albuminoids, and, like all antiseptics, retards the action of the ferments. As a practical result of these studies it follows that phosphoric acid is best fitted to take the place of hydrochloric acid in pepsin digestion. Although this had only weak effect on the albumen in solution, which forms the smaller part of our food, it had a noticeable effect in the case of solid albuminoid bodies.

Foods, nutritive value and cost, W. O. ATWATER (*U. S. Dept. Agr., Farmers' Bul. 23, pp. 32*).—This is a popular bulletin dealing with the nutrition of the human body, the composition and fuel value of food, nutritive value of different food materials, digestibility of food, dietaries and dietary standards, pecuniary economy of food, waste of food, and food and health. An appendix gives the composition of a large number of food materials, dietary standards, and 18 suggested dietaries with their composition.

Chemical composition of foods, E. F. LADD (*North Dakota Sta. Bul. 15, pp. 49-61*).—Analyses with reference to feeding value are given of timothy, orchard grass, Kentucky blue grass, mixed grasses, prairie hay, millet, medium red clover, alsike clover, alfalfa, wheat straw, oat straw, corn silage, oats, wheat, wheat screenings, wheat bran, linseed meal, and sedge seed; and analyses with reference to fertilizing ingredients of timothy, orchard grass, Kentucky blue grass, medium red clover, alsike clover, and alfalfa.

The composition of fodders, wheat, and milled products, H. SNYDER (*Minnesota Sta. Rpt. 1893, pp. 41-49*).—A reprint from Bulletin 27 of the station (E. S. R., 4, p. 733).

Stock feeding, H. P. ARMSBY (*Pennsylvania Sta. Rpt. 1893, pp. 13-24*).—This is a popular article on the principles of scientific feeding, composition of feeding stuffs, feeding standards, etc.

Digestion experiments, H. SNYDER (*Minnesota Sta. Rpt. 1893, pp. 3-40*).—A reprint of Bulletin 26 of the station (E. S. R., 4, p. 733).

Mangels and sugar beets vs. silage, H. J. WATERS and R. J. WELD (*Pennsylvania Sta. Rpt. 1893, pp. 37-52*).—This is a reprint of Bulletin 26 of the station (E. S. R., 6, p. 446).

Wheat feeding in Oklahoma, J. C. NEAL (*Oklahoma Sta. Bul. 13, pp. 73-76*).—Compiled information on the subject of feeding wheat to different kinds of farm animals.

On the comparative value of rape-seed cakes, V. STEIN (*Tidsskr. Landökon, 13 (1894), pp. 709-721*).

Colored rape-seed cakes, V. STEIN (*Landmandsblade, 27 (1894), pp. 765-767*).—The author calls attention to the artificial coloring of rape-seed cake, practiced to obtain the desired green color of the cakes and to disguise the admixture of inferior seed. The watery extract of the cakes gives strong reaction for lime, and is alkaline, while that of pure seed is acid.

The meat meal of commerce, A. ANDOUARD (*Ann. Agron., 21 (1895), No. 1, pp. 34-37*).—The food value of this material is briefly discussed, and danger from poisonous products of fermentation, and possibly the disease germs which it may contain, warned against.

Influence of quantity of food upon economy of milk and butter production, H. J. WATERS, W. H. CALDWELL, and R. J. WELD (*Pennsylvania Sta. Rpt. 1893, pp. 24-36*).—A somewhat less detailed account of this experiment was given in Bulletin 24 of the station (E. S. R., 5, p. 596).

Practical rations for lambs, W. M. HAYS (*Minnesota Rpt. 1893, pp. 193-200*).—A reprint of Bulletin 31 of the station (E. S. R., 5, p. 1083).

History of nutrition, L. BOURDEAU (*Histoire de l'Alimentation. Paris: 1894, pp. 372*).

The cost of keeping dry cows (*Landmandsblade, 27 (1894), pp. 783-786*).

Sheep raising, H. NATHORST (*Stockholm: 1894, pp. 173*).

VETERINARY SCIENCE.

Tuberculosis, E. P. NILES (*Virginia Sta. Bul. 39, pp. 43–54*).—This is a general discussion of tuberculosis. The results of a tuberculin test of the station herd and of one other herd are briefly stated, and attention is called to the fact that 1 animal which on *post-mortem* examination showed tuberculous lesions afforded when injected with tuberculin a reaction of only 1.1 degree.

DAIRYING.

Waste of fat in skim milk by the deep-setting process, W. H. JORDAN and J. M. BARTLETT (*Maine Sta. Rpt. 1893, pp. 95–100*).—This is a reprint of Bulletin 5 of the station (E. S. R., 5, p. 999), with a discussion of the necessity of submerging cans as compared with sinking them in the water to the depth of the milk in the can. The data presented in Bulletin 5 are considered with reference to this point. As a rule the skim milk from cans entirely submerged contains slightly less fat than that from cans not submerged or sealed.

"The value of submerging as a means of decreasing the waste of fat in the skimmed milk does not become apparent through the foregoing figures. It should be remembered, however, that in all these cases ice was used and kept in the tanks all the time. If this were not done the chances would appear to be in favor of submerging, because the greater the volume of water the less its temperature would be raised by cooling the warm milk."

Experiments in salting butter, W. S. SWEETSER and R. J. WELD (*Pennsylvania Sta. Rpt. 1893, pp. 58–60*).—In 3 separate trials the churning was separated into 3 equal portions, 1 portion being salted at the rate of 1 oz. per pound, another at the rate of 1½ oz. per pound, and the third not salted. In one case only ½ oz. of salt was used instead of 1½ oz. In 2 of the churnings a fourth portion was salted in the churn by the use of a strong brine. The separate lots of butter were all worked as nearly alike as possible, and samples were taken for the determination of water, fat, and salt. The results of the trials, including the analyses of the butter, are tabulated. The butter salted with ½ oz. of salt contained 11.7 per cent of water; that salted with 1 oz. averaged 9.84 per cent; with 1½ oz., 9.68 per cent; salted with brine, 12.09 per cent; and unsalted, 13.31 per cent. "The amount of salt retained in the butter varied in these trials from 1.35 to 6.02 per cent and seems to be dependent upon the amount of salt added." When the butter was salted with brine "practically none of the salt was retained. . . . Salting by this method seems to be labor and salt thrown away."

The composition of dairy products, H. SNYDER (*Minnesota Sta. Rpt. 1893, pp. 50–62*).—A reprint from Bulletin 27 of the station (E. S. R., 4, p. 150).

Butter substitutes, W. FREAR, J. W. FIELDS, and W. S. SWEETSER (*Pennsylvania Sta. Rpt. 1893, pp. 55–58*).—Analyses are given of 5 samples of butter, 4 of which were

found to be spurious. Remarks are also given on the interpretation of results of butter analysis, with compilations showing the average composition of butter.

An apparatus for airing and cooling fresh milk, B. BÖGGILD (*Mälkeritid., 7 (1894), pp. 717–721*).

Bacteria in their relation to the dairy, O. LUGGER (*Minnesota Sta. Rpt. 1893, pp. 259–290*).—A popular and quite comprehensive paper on bacteria and other microörganisms, their effect on milk and dairy products, sterilizing and pasteurizing milk, use of pure cultures in butter making, etc. The information appears to be wholly compiled.

The Colibri butyrometer (*Tidskr. Landtmän, 15 (1894), pp. 905–907; Nord. Mejeri Tidn., 9 (1894), p. 573*).—The apparatus, which is essentially a modified Babcock milk test, is manufactured at Stockholm; it is a hand machine, arranged for 20 bottles.

Warning against the use of preservatives for butter (*Tidskr. Landtmän, 15 (1894), pp. 915–918*).

TECHNOLOGY.

Grass-tree gum, J. H. MAIDEN (*Agl. Gaz. N. S. Wales, 5 (1894), No. 11, pp. 748–758*).—Notes on this resin, the species of *Xanthorrhœa* exuding it, its collection, and uses. *X. hastilis* exudes the resin most abundantly, but it is also secreted by *X. arboræ*, *X. australis*, *X. preissii*, and *X. tateana*. The gum varies in color from yellow to dark red, and also in consistency. It was used by the natives for fastening on the heads of spears, and is now used as a substitute for shellac and in candle making. It has also been employed medicinally in cases of dysentery. Experimental notes, analyses, and a bibliography of the subject are included.

On the quantity of wood gum (xylan) contained in different kinds of wood, J. OKUMURA (*College Agr. Bul., Tokyo, Japan, vol. 2, No. 2, pp. 76–78*).—Determination of the quantity of wood gum in 21 kinds of wood. "The Coniferæ are comparatively poor in wood gum and Ternstrœmia and Melia are also poor. Cupuliferæ are richer, Juglans, Magnolia, Cladrastis, Acanthopanax, etc., are still more so."

Essential oil of hops, A. C. CHAPMAN (*Jour. Chem. Soc. London, 1895, Jan., pp. 54–63*).

On certain changes in fats as they become rancid, A. SCALA (*Ann. Inst. Igien. Sper. (Roma), 6 (1894), pp. 353–362; abs. in Staz. Sper. Agr. Ital., 27 (1894), No. 4, pp. 424, 425*).—The fats investigated were butter, hog's lard, and olive oil. These were exposed to light and air and allowed to become rancid. The iodin numbers decreased constantly as rancidity advanced. To oleic acid rancidity was chiefly due. By oxidation it breaks up into similar compounds, liberating glycerin, which in turn is oxidized and transformed. As rancidity increases the ether numbers ascend, indicating the formation of aldehydes and oxy acids.

On the fat content of palm nuts, H. NÖRDLINGER (*Ztschr. angew. Chem., 1895, No. 1, pp. 19, 20*).

AGRICULTURAL ENGINEERING.

The ten-block system of numbering country houses, A. L. BANCROFT (*California State Bd. Hort. Rpt. 1893 and 1894, pp. 173–186, figs. 28*).—An illustrated paper giving in detail an ingenious scheme for blocking off and numbering country roads and houses according to a decimal system. Samples of its successful operation are given and the method is summarized as follows:

"The roads of an entire county are arranged in as long lengths as practicable and are all named. They are then measured, commencing at the county seat or at the end nearest to it, and each mile is divided into 10 equal parts or imaginary blocks, having frontage only. Two numbers are assigned to each block; one to each frontage, the odd ones upon the left and the even ones upon the right—10 blocks to a mile; 20 numbers to a mile. Any house having an entrance in a block has the number of that block. The number for all but the first house in a block is followed by a distinguishing letter—742, 742*a*, 742*b*, etc. Divide the even numbers by 2 and point off one decimal, and the distance in miles and tenths from the commencement of the road is shown."

Irrigation and cultivation (*California State Bd. Hort. Rpt. 1893 and 1894, pp. 343–348*).—A general discussion of the irrigation of orchards in central and northern California with special reference to peaches and prunes.

Fertilization in relation to irrigation, S. M. WOODBRIDGE (*California State Bd. Hort. Rpt. 1893 and 1894, pp. 315–318*).—A general discussion of the use of fertilizers and irrigation, insisting on the necessary connection of the two, and urging investigations in regard to the various amounts of water required for different crops.

Trials of plows at Storehedinge (Denmark), 1893, F. BOKELMANN, J. C. LA COUR, and H. F. K. DENCKER (*Tidsskr. Landökon. 12 (1894), pp. 745–802*).

Cultivation by means of steam plows, L. DANGER (*Landw. Wochenbl. Schles. Holst., 45 (1895), No. 1, pp. 5–9*).

History of tests of agricultural machinery in Denmark (*Tidsskr. Landökon. 12 (1894), pp. 737–744*).

STATISTICS.

Reports of director and of treasurer of Maine Station (*Maine Sta. Rpt. 1893, pp. 4, 7–9*).—The treasurer's report for the fiscal year ending June 30, 1893, and a brief general report on the work of the station by the director.

Annual Report of Minnesota Station for 1893 (*Minnesota Sta. Rpt. 1893, pp. 350*).—A brief review of the work of the year, list of the bulletins published by the station since its organization, treasurer's report for the fiscal year ending June 30, 1893, a reprint of Bulletins 26–32, with an index to the same, and an account of some hitherto unpublished investigations mentioned elsewhere.

Annual Report of Pennsylvania Station for 1893 (*Pennsylvania Sta. Rpt. 1893, pp. 7–13*).—This contains the treasurer's report for the fiscal year ending June 30, 1893, a brief review of the work of year by the director, and accounts of investigations noticed elsewhere.

Report of the statistician (*U. S. Dept. Agr., Division of Statistics Rpt. 122, pp. 705–778*).—The principal subjects treated are the following: Meteorological conditions of the year; crop review; statistics of the acreage, yield, and value in 1894 of the principal crops; farm prices December 1, 1894, of corn, wheat, rye, oats, barley, buckwheat, potatoes, sweet potatoes, hay, cotton, and tobacco; wholesale prices of corn, wheat, oats, barley, hay, cotton, butter, eggs, and tobacco in the principal cities in 1893 and 1894; statistics of agricultural exports and imports for 1893 and 1894; statistics of foreign crops; notes on foreign agriculture; and transportation rates. From the Abstract of the Eleventh Census of the United States tabular statements are compiled relative to the number, size, and value of farms; percentage of owned and rented farms; value of farm products per acre; and total value of land, improvements, machinery, and live stock in the different States.

MISCELLANEOUS.

Treatise on agriculture, A. ALOI (*Trattato di Agraria. vol. II, Agricultural. G. B. Paravia & Co., 1895, pp. 478*).

Advanced agriculture, H. J. WEBB (*London: Longmanns, Green & Co., 1894, pp. VI and 672*).

The education of gardeners, G. S. BOULGER (*Gard. Chron., 17 (1895), ser. 3, pp. 165, 166*).—To be continued.

Agricultural depression at home and abroad, W. E. BEAR (*Jour. Roy. Agl. Soc. England, 3d ser., 5 (1894), No. 20, pp. 673–695*).

The sale of cattle and the meat supply of Germany during 1891–'94, J. ARUP (*Tidsskr. Landökon. 13 (1894), pp. 685–708*).

The meat supply of England, 1893, J. ARUP (*Fifth Rpt. Danish State Agl. Councilors, 1893. Copenhagen: 1894, I–XIV*).

The conditions of North American competition in meat supply of England, N. HEYMAN (*Tidsskr. Landökon. 12 (1894), pp. 803–856*).

Agriculture in British Honduras (*Kew Misc. Bul. 97, pp. 9–11*).

Fifth Report of the Danish State Agricultural Councilors, 1893 (*Copenhagen: 1894, pp. 168*).

Annual Report of the Royal Danish Agricultural Society, 1893–'94 (*Copenhagen: 1894, pp. 180*).

Annual Report of the Royal Society for Norway's Weal for 1893 (*Christiania: 1894, pp. 102*).

Press bulletin excerpts (*Oklahoma Sta. Bul. 11, pp. 47–68*).—This is a summary of the more important articles furnished by the different departments of the station to the 15 press bulletins issued by the station since March, 1893.

NOTES.

Cornell University and Station.—A large room has been provided by the horticultural department to be used as a class room and museum, which will contain a collection of spraying apparatus, including every known device for spraying.

A law has been passed by the legislature of the State of New York appropriating $16,000 to be expended for horticulture in the fifth judicial department of the State, an area lying north and west of Cayuga Lake and including 16 counties. This fund is to be expended "in conducting investigations and experiments in horticulture; in discovering and remedying the diseases of plants, vines, and fruit trees; in ascertaining the best means of fertilizing vineyard, fruit, and garden plantations, and of making orchards, vineyards, and gardens prolific; in disseminating horticultural knowledge by means of lectures or otherwise, and in preparing and printing for free distribution the results of such investigations and experiments, and such other information as may be deemed desirable and profitable in promoting the horticultural interests of the State." All this work is to be prosecuted by Cornell University "under the general supervision and direction of the commissioner of agriculture." Agents and instructors are already in the field.

Ohio Station.—A substation is being established at Strongsville, Cuyahoga County, on the heavy clay soil which characterizes a large portion of northeastern Ohio. It is intended to duplicate on this soil the experiments with fertilizers which are being conducted at the station at Wooster and at the substations at Columbus and in Fulton County.

Pennsylvania Station.—The burning of the State printing office at Harrisburg. February 9, destroyed the manuscript of the Report of the State College and the Experiment Station for 1894. The loss involves a large amount of labor and expense, as the report was to be an unusually elaborate and highly illustrated one. Work has already begun on its reproduction, but its distribution will necessarily be somewhat delayed, as none of the cuts were saved.

Washington College.—The first annual winter school for farmers aroused much interest and enthusiasm among the farmers. The attendance represented 10 counties, and 303 were enrolled. The winter school will be made a permanent feature of the college work.

Analysis of Soils and Ash.—In conformity with the expressed desire of the Association of Official Agricultural Chemists at its last convention, that the availability of potash and phosphoric acid in soils should be made a subject of investigation during the present year, the "Directions for work on soil and ash samples" of the reporters on soils and ash recently issued provide, among other things, for the determination of the potash and phosphoric acid dissolved by digestion of the soil in 1 per cent citric acid for five hours with frequent thorough shaking; digestion for the same length of time in a solution of 6.3 gm. of oxalic acid in 1 liter of water; and digestion in the same manner in a solution containing 20 gm. of crystallized oxalate of ammonia and 2.15 gm. of anhydrous acetic acid. "The soils selected for study are from experimental fields that have been in cultivation as such for a series of years and the character of the soil is well known. One contains an abundance of available phosphoric acid, but not enough available potash, as shown by its responding to potash fertilizers in the field and not to phosphates. The other responds

promptly to phosphates, and hence is probably deficient in available phosphoric acid. The plan is to demonstrate this difference by the action of solvents, and by selecting the solvent and method of treatment that is found to yield results in closest relation to the field results we will have the basis of a method for determining chemically the soil's needs."

PERSONAL MENTION.—Prof. R. Warington, the newly elected professor of rural economy of Oxford University, delivered his inaugural lecture February 4, the subject being the "Present relations of agricultural art and natural science."

Dr. A. Koch has been chosen professor of physiological botany in Göttingen.

EXPERIMENT STATION RECORD.

VOL. VI. NO. 9.

At the last convention of the Association of Official Agricultural Chemists the abstract committee was requested to arrange for the periodical publication of their abstracts in the Experiment Station Record, the object being to make the abstracts more promptly available to the members of the association. This committee consists of five persons, and was first provided for at a meeting of the association in 1892. Its function is to prepare abstracts of current work on methods of analysis. Previous to that time a review of the work of the year had usually been furnished by the reporters on methods, each confining himself to his own special subject. It was expected that the abstract committee would not only relieve the reporters of this work but would also cover the ground more completely. The committee for 1894-'95 consists of W. Frear, of the Pennsylvania State College, chairman; W. D. Bigelow, of the Division of Chemistry of this Department; J. P. Street, of the New Jersey State Station; W. E. Stone, of Purdue University, Indiana; and R. H. Loughridge, of the University of California. This committee has arranged for the publication of its abstracts in the Record, and several abstracts have already appeared. The names of the members of the committee are attached to the abstracts prepared by them. It is hoped that by the coöperation of the association and the Division of Chemistry with this Office a quite complete survey of the work in agricultural chemistry now in progress throughout the world may be promptly presented to the readers of the Record.

In the present number of the Record Dr. Ewald Wollny begins a short series of articles in continuation of those published in volume 4, in which he will present a summarized statement of the results of investigations on the physical properties of soils. Renewed interest is being taken in soil investigations at home and abroad, especial prominence being given to studies of the physical properties and the bacteriology of soils. This is shown by the recent establishment of the Division of Agricultural Soils in this Department, which will give a very prominent place to studies of the physical properties of soils; by the investigation of the chemical composition and bacteriology of soils undertaken by the Division of Chemistry; and by the recent official announcement that the United States Geological Survey will broaden the scope of its work to

include the nature and history of soil formations and the mapping of soil areas. As this subject is very complex, it is desirable that the various lines of investigation may before long be established on a thorough and permanent basis in different parts of the country through the coöperation of this Department, the experiment stations, and the agricultural colleges. There are three principal lines of investigation: The chemistry of the soil, in which a vast amount of data has been accumulated, for which there is at present no satisfactory interpretation, but in which there is yet important work to be done upon methods of chemical analysis and upon the form of combination in the soil; the bacteriology of the soil, which has hardly yet been placed upon a systematic basis; and the physical properties of soils. This last should include the texture and structure of soils and their relation to water and heat. The origin and the formation of the soils and their geological classification and areal mapping should be considered, as well as the effect of soil conditions, especially the amount of moisture existing in different types of soil or maintained by different methods of cultivation, upon the physiology of the plant. Meteorology should likewise be studied in all its bearings upon soil areas and different soil formations. A serious hindrance to the organization of a wide and thorough system of soil investigation in this country is the lack of instruction in this important subject in our colleges, and of properly trained experts to carry out the details of the work. Opportunities are open now for a considerable number of workers in these lines. In view of these facts more attention should be paid to those branches which have a direct bearing upon original research in soils, and several centers of instruction should be established in certain sections of the country, presided over by men who are authorities on soil studies and who are themselves carrying on important soil investigations. It is important, in the first place, that a well-considered and systematic course of instruction bearing upon soil investigations should be presented at these institutions. The special line of research should depend partly upon the environment and condition of the institution. Different portions of our country offer exceptional advantages for work in one or more of these lines. The physical and physiological problems can best be studied in the arid regions where irrigation is practiced and the water supply can be controlled. In the Middle and Southern Atlantic and Gulf States suitable material for inquiries on the geologic problems is found in the wide number of distinctly typical soil conditions there represented. In the glaciated area none of these problems can be so well investigated, but chemical and bacteriological studies of soils can be as well carried on there as elsewhere. Specialization will count for as much here as elsewhere, and it will be far better that only a few well-equipped institutions should undertake this work and stake their reputation largely upon it. Great soil areas and great agricultural conditions must be considered, rather than interests bounded by State lines.

THE PHYSICAL PROPERTIES OF THE SOIL.

Dr. Ewald Wollny.

PART 1.

Having already shown[1] the significance of the physical properties of the soil in the growth of plants, I shall attempt in the following pages to set forth briefly, in the light of investigations made up to the present time, the nature of these properties and the corresponding differences among soils of different kinds under varying external conditions.

I.—THE PRINCIPAL SOIL CONSTITUENTS.

We may regard quartz, lime, clay, and humus as the principal constituents of the soil which influence its texture or mechanical character, and hence its behavior toward water, air, and heat, although under certain conditions a similar influence may be exercised by iron compounds and certain salts. In so far as the character of the mass depends on the size of its component particles, the constituents may be divided into sand (fine and coarse), finer particles which can be easily washed away (silt) and humus. The fact that these substances have very different properties, and occur in widely varying proportions, explains the marked differences that exist in the physical properties of natural soils, and a knowledge of the principal peculiarities of these individual constituents, and of their mutual relations, as well as of the proportions in which they are present in any particular instance, is therefore of primary interest and importance.

II.—GENERAL PHYSICAL PROPERTIES OF THE SOIL CONSTITUENTS AND OF THE SOIL AS A WHOLE.

THE SIZE OF THE SOIL PARTICLES.

The size of the soil particles varies within wide limits. In plastic clays the size of the grains is between 0.0001 and 0.005 mm.;[2] in the coarsest kinds of sand they are as high as 2 mm. in diameter. The extreme variation is therefore between 0.0001 and 2.0 mm. That part of the soil consisting of particles 2 to 5 mm. in diameter is called gravel, 5 to 10 mm. coarse gravel, and above 10 mm. stones. The portion made up of particles over 0.25 mm. in diameter is termed the "soil skeleton," that of finer grains the "fine earth." According to the preponderant size of the grains we distinguish between gravelly, sandy, coarse-grained, fine-grained, and dusty soils.

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[1] E. S. R., 4, pp. 528, 627.

[2] M. Whitney, U. S. Dept. Agr., Weather Bureau Bul. 4.

THE FORM OF THE SOIL PARTICLES.

This is generally very variable. The finest particles of clay are long and rounded, and rather uniform in shape; in sands the grains are frequently more or less cubical. Most of the other soil elements are of angular and irregular form.

Molecular constitution of the soil particles.—All particles of mineral origin are either crystalline or amorphous. In the former, and to a certain extent in the latter case, they are nearly or quite impermeable to water and gases. Some of the amorphous constituents have the properties common to colloid substances of swelling up in presence of water and forming a sort of jelly, and of returning to their original condition on drying. Examples of such colloid substances are the plastic constituents of clay, the amorphous zeolitic silicates, ferric oxid, silicic acid in certain conditions, and humus. These materials, although to a considerable extent hypothetical, are of great significance in the study of the physical and chemical properties of the soil. Upon them depends the plasticity of clay soils. Decaying plant remains render soils more porous and hence more permeable to gases and liquids.

Determination of the size of the particles (mechanical analysis), and of the soil constituents.—Mechanical analysis of soils, by means of sieves, or by elutriation, consists in the separation of the soil into portions of varying coarseness, and the quantitative determination of the proportions of these different grades. In this way the soil may be separated into the following products:

Grades obtained in mechanical analysis of soils.

Soil skeleton	(1) Over 10 mm. diameter	stones.
	(2) 10 to 5 mm. diameter	coarse gravel.
	(3) 5 to 2 mm. diameter	medium gravel.
	(4) 2 to 1 mm. diameter	fine gravel.
	(5) 1 to 0.5 mm. diameter	coarse sand.
	(6) 0.5 to 0.25 mm. diameter	medium sand.
Fine earth	(7) 0.25 to 0.1 mm. diameter	fine sand.
	(8) 0.1 to 0.05 mm. diameter	coarse silt.
	(9) 0.05 to 0.025 mm. diameter	medium fine silt.
	(10) 0.025 to 0.005 mm. diameter	fine silt.
	(11) 0.005 to 0.0001 mm. diameter	colloid clay.

Grades 1 to 5 are separated by sieves with circular holes, grades 7 to 11 by elutriation.

In preparing a sample of soil for analysis care must be taken that the coarser materials are freed from finer particles, and that all lumps are broken up. This is effected by boiling for 10 to 20 hours with distilled water.[1] The sample so treated is washed through a sieve with round holes by means of distilled water, using a brush if necessary.

Elutriation may be carried out in two ways. One of these depends on the subsidence of solid bodies in water and may be called the decan-

[1] E. W. Hilgard, Forsch. Geb. agr. Phys., 2, p. 57.

tation or hydrostatic method (Davy, Schübler, Sprengel, Benningsen-Förder, Knop, Schlösing, Kühn, Osborne, Fadejeff). The other depends on the force of upward flowing water, or hydraulic pressure, and is called the hydrodynamic method (Nöbel, Schöne, A. Mayer, Hilgard). Of the modifications of the first or hydrostatic method, Kühn's is preferable for ordinary work on account of its simplicity; Fadejeff's method, however, gives more exact and more closely agreeing results. Of the hydrodynamic methods, those using a conical washing vessel (Nöbel, Schöne, A. Mayer) give unsatisfactory results, on account of the backward currents along the sides of the vessel, which produce flocculent aggregates of the smaller grains which sink to the bottom and remain with the coarser sand. To avoid this difficulty Hilgard uses a vertical cylindrical tube and an agitating apparatus the object of which is to destroy any floccules that may be formed. Hilgard's apparatus may be regarded as the most satisfactory, at least for particles less than 0.1 mm. (8 mm. hydraulic value), which has yet been devised.[1]

In carrying out mechanical soil analysis of any kind various precautions must be observed in order to insure accuracy. Besides the 10 to 20 hours' brisk boiling of the sample which is essential, water as pure as possible (distilled) must be used in the elutriation, because in water containing salts floccules are apt to form which settle and remain with the coarser ingredients. For the same reason the apparatus must be protected from all variations of temperature and from strong light. It is therefore best placed in a dark cellar which is subject to only slight variations in temperature. For the accurate separation of sediments of definite hydraulic value the elutriation must be preceded by the removal of the clay, as otherwise the heavy, clayey water, having a high hydraulic value, will carry away larger particles than correspond to the real velocity of the water. The other particles may be separated from the clay by repeated sedimentation in a column of water 20 cm. deep for periods of 24 hours.[2]

The separation of soil into the above-mentioned portions furnishes a basis for interpretation of those physical properties which depend upon the size of the soil particles, but throws no light on the influence in this respect of colloid and humus substances. Colloid clay[3] is the most important of the former class, for to it is due the property of plasticity. Kaolin particles occur in the soil, but they behave like any other mechanical constituent, and are no more plastic than chalk or fine siliceous earth. For the determination of "active" clay the method

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[1] F. Wahnschaffe, Anleitung zur wissenschaftlichen Bodenuntersuchung, 1887, p. 23. T. B. Osborne, Forsch. Geb. agr. Phys., 10, p. 196. E. W. Hilgard, Ibid., 2, p. 57, and 6, p. 52. A. Mayer, Ibid., 5, p. 228.

[2] E. W. Hilgard, Forsch. Geb. agr. Phys., 6, p. 53.

[3] M. Whitney and others have recently ascribed the properties of colloid clay and other similarly constituted substances to the extreme fineness of their particles, and hence the very much greater attraction the latter can exert compared with any substances made up of comparatively coarse grains.

of Hilgard just mentioned, or that of T. Schlösing, may be used.[1] The clay sediment, however, may contain fine particles of other substances besides clay, such as quartz, ferric hydrate, etc., and it may be necessary to determine these chemically and subtract the weight of these from the total weight of the sediment.

The humus substances are also determined chemically, especially the colloid humus matter (*matière noire*) which is physically very important. This determination is best made by Grandeau's method.[2]

When the constituents themselves are considered in their relation to the properties of the soil, aside from the effect due simply to the size of the particles, as for instance with reference to the conduction of heat, chemical analysis can not be dispensed with, for mechanical examination can not give the necessary information.[3] Under certain circumstances it may be of importance to make an examination of the mineral constituents of the different sediments.[4]

THE ARRANGEMENT OF THE SOIL PARTICLES (STRUCTURE OF THE SOIL).

Separate grain structure.—If we consider a soil divided up into its individual particles, which are massed together more or less closely, we

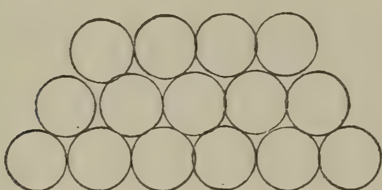

FIG. 4.

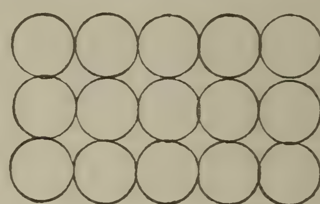

FIG. 5.

see that the size of the interstitial spaces and consequently the movement of water and air in the soil are dependent solely on the size and form of the particles. This arrangement is called (after Hilgard) the "separate grain structure" (*Einzelkornstructur*). If the particles are spherical and of equal size they can be supposed to be massed together in either of two ways: (1) Each sphere rests in the space between the adjoining spheres (Fig. 4), or (2) the planes tangents to the spheres at all their points of contact intersect at right angles. The former arrangement produces a three sided or four sided regular pyramid while the latter gives rise to a cubical form (Fig. 5). In the first case the arrangement is the most compact possible and the volume of the intergranular space (volume of pores) amounts to 25.95 per cent of the total volume. In the second case we have the least compact arrangement, and the volume of the pores rises to 47.64 per cent of the total

[1] E. Ramann, Forstliche Bodenkunde, Berlin, 1893, p. 50.
[2] Jour. Agr. Prat., 36 (1872), No. 14–17. Compt. Rend., 74, p. 988.
[3] F. Wahnschaffe, l. c., p. 43–85.
[4] F. Steinriede, Anleitung zur mineralogischen Bodenanalyse, 1889.

volume.[1] The volume actually occupied by the solid particles is independent of the size of the spheres, in both the above cases, so long as all the spheres in the mass are the same size.[2]

In ordinary arable soils the conditions are somewhat different, due to the fact that the particles are not spherical and are of different sizes, and that external conditions exercise a considerable influence on the structure. The arrangement may be more compact than in the first case described above on account of the smaller grains depositing themselves in the spaces between the larger ones (Fig. 6), or may be less compact than in the second when the particles arrange themselves as in Fig. 7. Shaking and packing increase the density of the soil, but this is principally caused, and to the greatest extent, by the percolation of water, which acts mechanically on the soil (puddling it).

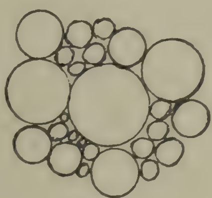

FIG. 6.

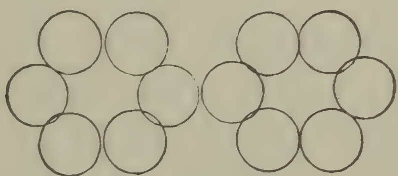

FIG. 7.

The volume actually occupied by soil particles is smallest, relatively, in soils containing porous fragments, especially those rich in humus (peat).

From what has been said it is not surprising that the volume of the pores, which depends on the arrangement of the particles, varies within wide limits in natural soils. According to the experiments made on this subject by C. Flügge[3] the volume varies in mineral soils between 20 and 57.8 per cent, while in peat and moor soils it may rise to 85.2 per cent, according to E. Ramann and A. R. von Schwarz.[4]

Crumbly structure.—In many soils aggregates or floccules are formed under certain circumstances. This kind of arrangement differs from that already described principally in the occurrence of a considerable number of larger spaces between the aggregates, owing to the virtually larger size of the particles. These larger spaces bring about very important differences in the physical properties of the soil, especially in its behavior toward water and air. This kind of arrangement of the soil particles is shown in Fig. 8.

There are various reasons for the formation of aggregates. The tendency is approximately inversely proportional to the size of the

[1] F. Soyka, Forsch. Geb. agr. Phys., 8, p. 1.

[2] C. Lang, Ibid., 1, p. 109.

[3] Beiträge zur Hygiene, Leipsic, 1879. E. Wolff, Anleitung zur chemischen Untersuchung landwirthschaftlich wichtiger Stoffe, 1875. F. Renk, Ztschr. Biol., 15. E. Ramann, l. c. Veitmeyer, Vorarbeiten zur Wasserversorgung der Stadt Berlin, 1871 and later.

[4] Forsch. Geb. agr. Phys., 2, p. 164.

particles concerned, and ceases for the most part in quartz powder when the diameter of the grains rises to 0.2 mm., supposing all the particles to be of the same size, for particles larger than 0.2 mm. diameter may enter into aggregates made up for the most part of smaller grains. The number of grains which can cohere in this way varies also in approximately the same manner. The larger the individual grains the more easily their aggregates fall to pieces. The occurrence of sediments of the same hydraulic value but of different specific gravity show that a higher density tends to diminish flocculation. This tendency also decreases rapidly with an increase in temperature, being very weak in water near its boiling point.[1] Colloid substances are also very influential in the formation of floccules, and the free insoluble humus acids produce the same result by binding the other constituents together.[2] The formation of aggregates is greatest when the soil contains a medium quantity of water, *i. e.*, about 40 per cent of the maximum quantity which it is capable of holding, and a greater or less quantity of water always diminishes the tendency toward flocculation.[3]

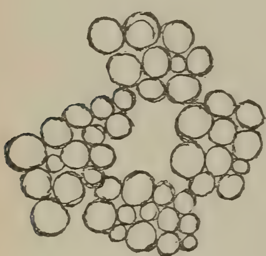

FIG. 8.

Of secondary importance is the fact that the soluble salts of the soil, even when present in very small quantities, exert an important influence on its structure.[4] Caustic alkalies (potash, soda, and ammonia), as well as their carbonates and phosphates, cause a compact arrangement of the individual grains, and hinder or prevent the formation of aggregates, while the mineral acids (hydrochloric, sulphuirc, and nitric) and their salts, with the exception of the neutral alkaline sulphates, which rather approach the preceding group in behavior, materially aid flocculation. In the case of the chlorids and nitrates this is true only while they remain in the soil liquids. When they are washed out by the atmospheric water, which readily takes place, a more compact arrangement of the individual atoms results. Calcium hydrate (caustic lime) and, to a less extent, calcium carbonate help to form light, loose aggregates, which resist external influences tending toward their disintegration for a longer or shorter time, according to the quantity of the flocculating substance present.

Among external factors which influence the structure of the soil frost is of first importance. By the freezing and consequent expansion of the water the particles are torn apart. In a compact soil having a tendency to form floccules frost will, as a rule, bring about a crumbly structure, while in a soil already mechanically finely divided the par-

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[1] E. W. Hilgard, Forsch. Geb. agr. Phys., 2, p. 441.
[2] T. Schlösing, Compt. Rend., 64, p. 1408.
[3] H. Puchner, Forsch. Geb. agr. Phys., 12, p. 239.
[4] E. W. Hilgard, Forsch. Geb. agr. Phys., 2, p. 441. A. Mayer, Ibid., p. 251.

ticles will be either so far separated as to cause the formation of the "separate grain" structure, or may be more closely consolidated by the action of frost.

Destruction of the crumbly structure is promoted by violent shaking with water, kneading, and boiling of the mass. These means, as is well known, are used in pottery work to increase the plasticity of the clay, the object being to break up aggregates of particles as completely as possible.

Atmospheric water exerts a decided influence on the structure of the soil by altering the position of the soil particles and also by carrying the smaller grains downward. The crumbly structure of the soil is destroyed more or less by the percolating water, which loosens particles from the fragments and washes them into the larger spaces, and this takes places in proportion to the quantity of the percolating water and the lack of tendency toward flocculation in the soil. The greater the force of the falling water the sooner the soil assumes the separate grain structure, and therefore violent thunderstorms may entirely change the mechanical condition of the soil in a short time. From such facts we may infer that the frequency of atmospheric precipitation, other things being equal, exercises a great influence on the structure of the soil. Frequent light rainfalls have much less effect than violent storms at longer intervals.

Covering the soil with living or dead plants lessens the mechanical effect of atmospheric precipitation by breaking the force of the falling water and retarding its penetration into the soil, and this influence of plant cover varies with its compactness and state of development. If the ground is covered with straw, the compacting of the soil by rain will diminish as the thickness of the covering increases.[1]

Structural changes in the soil may also be caused by the washing away of the surface particles on sloping land by the water that does not sink into the soil (erosion). In the case of leaching, the washing of the smaller particles into the subsoil increases with the differences in the size of the particles; in the case of erosion the washing away of the finer-grained constituents is greater the less compact the soil, the greater the slope, and the heavier the rainfall. In both cases change in position of the soil particles is prevented to a great extent by a covering of living plants whose roots hold the soil together. Forest growth has a stronger retarding action than that of perennial herbs.

The wind transports the finer particles of dusty soils in proportion to its strength. The places from which the material has been blown necessarily have a coarser soil structure than those composed of the deposited dust.[2]

Finally, the animal life of the soil exerts an important influence on

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[1] E. Wollny, Forsch. Geb. agr. Phys., 12, p. 31.
[2] T. F. Hensele, Ibid., 16, p. 311.

the formation of aggregates. This is especially true of the ordinary earthworm, whose digging, burrowing, and excretions are important agencies in the formation of vegetable mold.[1]

CHANGES IN VOLUME OF THE SOIL.

Variations in the volume of soils are shown by changes in the space occupied when different quantities of moisture are present. These changes are most marked in soils which contain much colloid material (clay, and especially humus matter), while in sands they are not observed, or only to a slight extent in very fine sands. In the latter case the expansion is due solely to the surrounding of particles by water when the soil is very wet.[2]

In clays and clayey soils the changes in volume consequent on drying cause a vertical and especially a horizontal tension in the mass. Loss of water at the surface of the soil causes a contraction of the uppermost layer and a consequent strain from below upward, reaching to a depth dependent upon the depth of the surface drying. Under such circumstances the soil must become more closely compacted and the surface sink to a lower level. These changes in volume often cause cracking of the soil, chiefly due to the horizontal tension already mentioned. This separation of the soil particles will decrease as the force increases which holds the particles together, that is, as the cohesion of the soil increases (see below). Experience teaches, however, that even the most tenacious soils have not sufficient resistance to prevent the formation of cracks by lateral tension when drying proceeds to a considerable extent. It is plain that this tension is not uniform either at the surface or below because the drying and the consequent contraction goes on more quickly in some parts of the soil than in others. The top layers dry soonest and most completely and therefore contract more strongly than the lower and moister strata. The cracks formed, then, will be widest at the top and will become narrower on descending.[3]

The cracks formed in the same soil by drying are deeper, narrower, and less numerous the more compactly the particles are arranged, and *vice versa*.[4]

Expansion and contraction of the soil are also observed in freezing and thawing, and the greater the quantity of water in the soil the more marked are the changes in volume due to this cause, being especially marked in soils rich in humus and clay.

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[1] C. Darwin, The Formation of Vegetable Mold Through the Action of Earthworms, 1882. V. Hensen, Landw. Jahrb., 1882, p. 661. P. A. Müller, Die natürlichen Humusformen, 1887. E. Ramann, Forsch. Geb. agr. Phys., 11, p. 299. E. Wollny, Ibid., 13, p. 382. E. Ebermayer, Allgemeine Forst- und Jagdztg., 1891, p. 71.

[2] G. Schübler, Grundsätze der Agriculturchemie, 1838, pt. II, p. 82. E. Wolff, l. c., p. 71. F. Haberlandt, Fühling's landw. Ztg., 1877, p. 481. A. R. von Schwarz, Forsch. Geb. agr. Phys., 2, p. 166.

[3] F. Haberlandt, Wissenschaftlich-practische Untersuchungen auf dem Gebiete des Pflanzenbaues, 1875, vol. 1, p. 22; Forsch. Geb. agr. Phys., 1, p. 148.

[4] E. Wollny, Forsch. Geb. agr. Phys., 5, p. 43.

THE COHESION OF THE SOIL.

Cohesion is the force with which soil particles adhere to one another. As a measure of this we may use the resistance which the soil opposes to a separation by tension (relative firmness) or pressure (absolute firmness), or to the penetration of a wedge-shaped body (resistance to separation). Cohesion depends on the mechanical constitution and the humidity of the soil as well as on the presence of different salts. Of the soil constituents clay possesses the greatest cohesive power, while the particles of quartz, humus, and lime are comparatively weak in this respect. The cohesion of a soil, therefore, increases with the quantity of clay it contains and diminishes as the quantity of quartz, humus, or lime increases. Under otherwise similar conditions the attraction between the soil particles is greatest when the particles are smallest. It also depends on their arrangement. Soils with separate grain structure, other conditions being the same, have a higher cohesion than crumbly soils. By pressure the cohesion is increased in proportion to the force acting. The influence of water is apparent in the fact that in clays and soils rich in clay the cohesion is greatest when the quantity of water present is least, while in humus, quartz, and chalk the constituents of the soil cohere most strongly when a definite proportion of water is present, either more or less than this quantity causing a decrease in cohesion. The freezing of water in the soil causes a remarkable increase in the resistance offered to the penetration of a wedge-shaped body (resistance to separation), and also to forces tending to break up the mass (absolute firmness). By mixing caustic lime with clay the firmness of the latter is considerably diminished for all states of moisture, while potassium hydrate or alkaline carbonates increase the cohesion in the dry state and seem to decrease it when the mass is very moist. Other conditions being equal, the resistance to the entrance of wedge-shaped bodies is much greater when the soil is covered with plants than when bare.[1]

THE ADHESION OF THE SOIL.

This property is apparent in the fact that the soil adheres to a greater or less extent to the wood and iron parts of agricultural implements. From the investigations on this subject, it appears that a number of circumstances seem to influence the force which causes adhesion.[2] It is proportional to the surface in contact and increases with the amount and duration of pressure.

In sandy soils (quartz and calcareous sand) adhesion is greater the

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[1] W. Schumacher, l. c., p. 125. G. Schübler, l. c., p. 74. F. Haberlandt, Wissenschaftlich-practische Untersuchungen auf dem Gebiete des Pflanzenbaues, 1875, vol. 1, p. 22; Forsch. Geb. agr. Phys., 1, p. 148. H. Puchner, Ibid., 12, p. 195.

[2] G. Schübler, l. c., p. 76. F. Haberlandt, Der allgemeine landwirthschaftliche Pflanzenbau, 1879, p. 393. F. Schachbasian, Forsch. Geb. agr. Phys., 13, p. 193.

smaller the particles; in powdery soils (separate grain structure) adhesion is considerably higher than in the same soil in a crumbly condition. Of the different soil constituents, clay shows the strongest adhesion to wood and iron and humus the weakest, while quartz is intermediate. The soil, therefore, adheres to the implements most strongly when it is rich in clay and less strongly when quartz and humus predominate. The influence of water varies in differently constituted soils. In sandy soils adhesion increases with an increase of water up to complete saturation. In soils rich in clay adhesion to wood and iron reaches a maximum at a definite humidity (80 per cent of the quantity required for saturation), below and above which adhesion decreases. Humus seems to act like quartz, in respect to the influence of moisture. In the dry state, adhesion in all kinds of soils is zero.

The addition of caustic lime has no appreciable effect on the adhesion of soil to agricultural implements, but caustic alkalies seem to cause a firmer adhesion of clay.

Clayey soils adhere to wood more firmly than to iron, while with soils rich in quartz and humus the reverse is true. Adhesion of soils to rusty iron is almost invariably less than to polished iron, and in case of soils rich in clay, less than to wood. Only in soils containing much quartz are the adhesive values greater for rusty iron than for wood.

THE FRICTION OF SOILS ON WOOD AND IRON.

The resistance which is offered by friction to the sliding of implements over the soil is expressed by the ratio of the force which is necessary to overcome the resistance to friction to the weight of the moving or sliding body (coefficient of friction). This coefficient varies, according to the nature of the materials concerned, between 0.33 and 0.82. Other properties being the same, fine-grained soils show a greater resistance when moist than when dry. If the soil is moist, the resistance offered to wooden and iron implements is greater when the soil has the separate grain structure than when it is crumbly, but if the earth is dry the reverse is true. As regards the behavior of the various soil constituents, experiments[1] show that the coefficient of friction is greatest in quartz sand or calcareous sand, and smallest in clay, while humus possesses an intermediate value. The coefficient of friction diminishes with the quantity of moisture in the soil, and is greater for wood than for iron. Rust increases considerably the coefficient of friction for iron.

THE SPECIFIC GRAVITY OF THE SOIL.

This is the ratio of the weight of the soil to that of an equal volume of water considered as unity. For different soil constituents the following values have been found (E. Wollny):

[1] F. Schachbasian, Forsch. Geb. agr. Phys., 13, p. 214.

Specific gravity of soil constituents.

Quartz	2.622
Clay	2.503
Lime, carbonate crystalline	2.756
Lime, carbonate precipitated	2.678
Gypsum, precipitated	2.318
Oxid of iron	4.54–5.20
Hydrated oxid of iron	3.760
Humus	1.462

With these values it is possible to calculate the density of any soil.

The more important minerals occurring in soil have the following specific gravities:[1]

Specific gravity of different minerals.

Feldspar	2.5 to 2.8	Calcite	2.6 to 2.8
Orthoclase	2.5 to 2.6	Dolomite	2.8 to 3.0
Oligoclase	2.6 to 2.7	Chlorite	2.7 to 3.0
Labradorite	2.6 to 2.8	Talc	2.6 to 2.7
Augite	3.2 to 3.5	Magnetite	4.9 to 5.2
Hornblende	2.9 to 3.4	Limonite	3.4 to 4.0
Mica	2.8 to 3.2	Hematite	5.1 to 5.2
Potash mica	2.8 to 3.0		
Magnesia mica	2.8 to 3.2		

THE VOLUME WEIGHT OF THE SOIL.

This is also called apparent specific gravity, and is the weight of a given volume of the soil compared with an equal volume of water. In the specific gravity we are concerned only with the volume of the actual solid matter of the soil, exclusive of the air or water that occurs in the spaces between the particles; in the volume weight we consider the soil as a whole, including the spaces occurring in it.

According to the investigations of the author[2] quartz has the highest volume weight in the air-dry state (1.4485), humus the lowest (0.3349), and clay a value intermediate between the two (1.0108). The volume weight of soils, other things being equal, increases with the presence of iron and stones. The volume weight of one and the same soil depends on the mode of arrangement of the particles and is subject to great variations. The more compactly the particles are arranged the greater is the weight of the mass, when equal volumes are considered, and *vice versa*. Under otherwise similar circumstances the coarser the grains the higher the volume weight. A mixture of grains of different sizes has a higher volume weight than a mass composed of grains of the same size, large or small. By the formation of floccules in a soil, its volume weight is decreased in proportion to the coarseness of the aggregates formed.

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[1] G. Schübler, Grundsätze der Agriculturchemie, 1838, pt. II, p. 61. C. Trommer, Die Bodenkunde, 1857, p. 258. A. von Liebenberg, Ueber das Verhalten des Wassers im Boden, Inaugural-Dissertation, Halle, 1873. C. Lang, Forsch. Geb. agr. Phys., 1, p. 136. G. Ammon, Ibid., 2, p. 26. E. Wollny, Ibid., 8, p. 347. E. Ramann, Forstliche Bodenkunde, 1893, p. 61.

[2] Forsch. Geb. agr. Phys., 8, p. 349.

With regard to the influence of water, experiments have shown that the volume weight of soils increases with the water content, and the increase is proportional to the water capacity of the soil. The differences in volume weight correspond, in general, when soils are approximately equally saturated, to those in air-dry soils, though the values are more concordant in moist soils.

The expressions "heavy" and "light" soils, used in practice, have no reference to the weight of the mass, but to the resistance which the soil opposes to cultivation.

It is sometimes advisable to examine the soil in its natural state on account of the not inconsiderable variations in the volume weight. This is most conveniently done by lifting out a column of the soil by means of a sampling tube which is driven to a definite depth in the earth and drying and weighing the sample.[1]

THE COLOR OF THE SOIL.

This is due to the presence of certain constituents. The principal mineral ingredients of the soil (clay, lime, and quartz) are white when pure. When the soil is of some other color it is caused by the presence of humus matter or iron compounds. The humus substances produce a gray, brown, or black color, according to the quantity present, while iron, as ferric oxid or hydrate, causes a yellow, brownish, or red color. The coloring power of these constituents depends on the constitution of the soil. In sands 0.2 to 0.3 per cent of humus materials or 1 per cent of ferric oxid or hydrate suffice to cause either a gray or a red or brown coloration in the dry state, but in clays more (2 to 5 per cent humus, 5 to 10 per cent ferric oxid or hydrate) is required to produce the same effect. This is due, as a rule, to more intimate mixture of the clayey soils with the coloring matters. A green coloration is almost without exception caused by ferrous compounds, and is seldom noticed in well aërated soils.

A change in color in a soil is caused on the one hand by a change in humidity, on the other by a change in the iron compounds. In general, soils are darker colored when they contain more water, and *vice versa*. This is especially true of soils containing much humus, which are dark brown or black when wet, become lighter as the moisture decreases, and when dry show a gray or whitish-gray color. Soils colored red or brown by ferric oxid or hydrate assume a lighter color and under certain circumstances (deficiency of air) a greenish color when these compounds are converted into ferrous compounds. The reverse process, *i. e.*, the oxidation of ferrous salts, is shown by an immediate change in the color of the mass to yellow, red, or brown.[2]

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[1] G. Schübler, l. c., p. 61. Meister Programm des Jahresberichtes, 1857-'58 der k. landw. Centralschule zu Weihenstephan, 1. A. von Liebenberg, l. c., p. 6. E. Wollny, Forsch. Geb. agr. Phys., 8, p. 349. E. Ramann, l. c., p. 62.

[2] W. Schumacher, Die Physik des Bodens, 1864, p. 139. E. Ramann, Forstliche Bodenkunde, 1893, p. 36. E. Wollny, Forsch. Geb. agr. Phys., 4, p. 354.

THE STRATIFICATION OF THE SOIL.

The soil, as a whole, is by no means uniform, and this is especially true of sedimentary soils. Different soil layers have a different mechanical constitution, the difference being sometimes very great. Since the individual layers behave differently toward water, air, and heat, the determination of the arrangement of these layers is of particular importance. The stratification may be ascertained by the examination of vertical sections of soil exposed in pits dug at various suitable places or on the surface of columns of soil taken by means of a sampling tube. Information can also be obtained as to stratification of the soil by examining existing exposures, such as railroad and other cuts and excavations.

The upper layer of the soil, containing the roots of plants and altered by vegetable growth, is called "surface soil," while the layer below this is termed "subsoil." The surface soil includes two layers, an upper one or tilled soil, which is artificially altered by tillage, and a lower one influenced only by the growth of plants, and otherwise in its natural condition. We may therefore distinguish between an upper and a lower surface soil. In practical agriculture the term surface soil generally indicates only the upper layer or tilled soil, while the subsoil means the part of the soil below this. The subsoil here begins immediately below the tilled soil, no matter how thick or how thin this may be. The subsoil is sometimes regarded as that layer on whose texture the moisture of the upper layer depends (permeable or impermeable subsoil). A consistent and general terminology does not exist at present, but that suggested above corresponds best with natural conditions.[1]

THE DEPTH OF THE SOIL.

The depth of the soil means the thickness of that part which can be penetrated by the roots of plants. This is of great importance to crops, inasmuch as, within certain limits, they develop proportionately to the thickness of the layer in which they can extend their roots. The depth of the soil, therefore, is determined by the distance below the surface of the layer which prevents the growth of the subterranean organs of the plant. In mountainous districts the depth of the rock below the surface determines the depth of the soil. In level lands the depth of the soil is determined by the distance below the surface of layers of closely compacted materials (clay, rock, bog-iron ore) or of coarse gravel or sand, which prevent more or less completely the growth of the roots on account of their impenetrability, excess of water, or deficiency in the substance necessary to the life of the organs. With regard to the depth of different soils the following gradations may be noticed:

Thin soil	15 to 30 cm.
Medium soil	30 to 60 cm.
Thick soil	60 to 100 cm.
Very thick soil	above 1 meter.

[1] L. von Liburnan, Die geologischen Verhältnisse von Grund und Boden, 1883, p. 223. A. Nowacki, Practische Bodenkunde, 1892, p. 39. F. Dafert, Kleines Lehrbuch der Bodenkunde, 1885, p. 162. W. Schumacher, l. c., p. 326.

THE POSITION OF THE SOIL.

The surface of the soil is either horizontal or inclined; in the latter case the slope may be uniform or nonuniform, and vary in regard to the points of the compass and in respect to the horizontal. The compass direction is called the "exposure," the slant in respect to the horizontal is the "inclination."

The exposure may be easterly, southerly, westerly, northerly, or may have some intermediate direction. With regard to varying inclination we have the following gradations:

Level or slightly sloping	0 to 5° to the horizontal.
Sloping	5 to 10°.
Very sloping	10 to 20°.
Steep	20 to 30°.
Very steep	30 to 45°.
Precipitous	above 45°.

The exposure and the inclination are of great importance in many ways, because upon them depend the conditions of warmth and humidity of the culture layer, and also of erosion of the soil. The former consideration determines the choice of crop and the latter the possibility of cultivation.

RECENT WORK IN AGRICULTURAL SCIENCE.

CHEMISTRY.

Comparison of methods of sugar analysis as applied to grape juice (musts), G. E. COLBY (*California Sta. Rpt. 1893 and 1894, pp. 326, 327*).—A comparison is given on 3 samples of grape juice of the volumetric and gravimetric methods described in the Proceedings of the Association of Official Agricultural Chemists for 1892.[1] The results by the volumetric method and the electrolytic gravimetric method agreed quite closely, but the method of reducing the cuprous oxid in hydrogen gave results somewhat higher.

The unreliability of the Kjeldahl method for determining nitrogen in chloroplatinates, DELEPINE (*Bul. Soc. Chim. Paris, 13–14 (1895), No. 4, p. 222*).—Trials of this method on chloroplatinate of trimethylamin gave results in no way approaching the theoretical percentages of nitrogen. This was due to the escape of free nitrogen.

Researches on the separation of free hydrochloric acid from chlorids, especially in analysis of the gastric juice, H. LESCŒUR (*Bul. Soc. Chim. Paris, 13–14 (1895), No. 3, pp. 142–155, fig. 1*).

The transformation of starch into sugar, DUCLAUX (*Ann. Inst. Pasteur, 9 (1895), No. 1, pp. 56–64*).—A critical review.

Rapid determination of starch, P. L. HIBBARD (*Neue Ztschr. Rübenz. Ind., 34 (1895), No. 7, pp. 86, 87*).

The action of ammonia upon dextrose, W. E. STONE (*Amer. Chem. Jour., 17 (1895), No. 3, pp. 191–196*).

The carbohydrates of the gum of Acacia decurrens, W. E. STONE (*Amer. Chem. Jour., 17 (1895), No. 3, pp. 196–199*).—This gum "does not essentially differ from gum arabic or peach gum or cherry gum. It furnishes an additional example of the occurrence of a galacto-araban complex."

On the composition and analysis of brandy, X. ROCQUES (*Compt. Rend., 120 (1895), No. 7, pp. 372–374*).

The oxidation of tannin in cider, L. LINDET (*Compt. Rend., 120 (1895), No. 7, pp. 370–372*).—It is claimed, as pointed out by Bertrand (*Compt. Rend., 120 (1895), No. 5, p. 266*), that the brown coloration of the cider and marc is due to the energetic oxidation of the tannin present by a ferment similar to diastase which is designated *laccase*.

The determination of tannin in wines, A. VIGNA (*Staz. Sper. Agr. Ital., 28 (1895), No. 1, pp. 19–22*).

On the analysis of tannin compounds, A. GIRARD (*Compt. Rend., 120 (1895), No. 7, pp. 358–360*).—The discordant results obtained by different chemists with the author's method (*Compt. Rend., 95 (1892), p. 185*), are explained by variations in the character of the intestinal membrane used. The difficulty is removed by carefully purifying the membrane.

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[1] U. S. Dept. Agr., Div. of Chem. Bul. 35 (E. S. R., 4, p. 580).

A thermostat, BERLEMONT (*Bul. Soc. Chim. Paris, 13–14 (1895), No. 5, pp. 228, 229, fig. 1*).

An apparatus for grinding peanuts, J. G. W. KEMM (*Neue Ztschr. Rübenz. Ind., 34 (1895), No. 6, pp. 79, 80, pl. 1*).

Some new pieces of chemical apparatus, P. NYSSENS (*Rev. Agron. Louvain, 3 (1894), No. 4, pp. 245–252, figs. 4*).—Descriptions of fat extractor, mechanical agitator, and water bath with constant level.

BOTANY.

The method and application of a quantitative botanical analysis of meadows, A. VOIGT (*Landw. Jahrb., 23 (1894), No. 4 and 5, pp. 707–788, figs. 2*).—The author reviews the methods heretofore employed in making botanical analyses of meadows, and points out some of their deficiencies. The value of botanical analyses as compared with chemical analyses is shown. Chemical analysis of grasses does not always represent the true value of meadows either for pasturage or hay as well as a botanical analysis, as from the latter may be seen the relative value of various species, based on the avidity with which stock will eat them.

The method suggested by the author for securing representative material for a quantitative botanical analysis of an area of 1 are is as follows: Immediately after mowing from each swath at distances of about 50 cm., specimens are taken in proportion to the size and abundance of the material. This forms what is called type 1, and will weigh from 17 to 30 kg., depending on the abundance of the material. This type is then spread about in a circle of 1.5 to 2 meters in diameter until it is of a uniform thickness and of apparent homogeneity. From this circle type 2 is taken, by removing a handful at a time from different parts of the circle until about one fourth of the total quantity is secured. This type is similarly treated to secure types 3 and 4, the final one of which will weigh from 2 to 4 kg. From this last so-called type the botanical determinations are made, a part being retained for control analysis. When strong plants, as thistles, meadow sweet, etc., are present, they must be broken up, so as to permit of a more even distribution of their material. The principal difficulty in such an analysis will be with the grass leaves, such as are found in aftermath. These must be removed, assorted, weighed, and their proportion to the whole ascertained. Their determination is difficult, and should be made by a specialist. The same is true of the sedges, mosses, etc. In this way the species of plants found in a meadow and their relative abundance may be determined with reasonable accuracy.

The author divides the more common grasses into 4 categories, the groups and species being arranged according to their relative value for forage, the first being considered the best, the others decreasing in value according to their position in the list. Group 1, *Festuca elatior, Lolium perenne, Dactylis glomerata, Arrhenatherum elatius, Avena flavescens, Phleum pratense, Poa pratensis, P. trivialis, Agrostis alba, Glyceria fluitans, G. aquatica*, and *Cynosurus cristatus*. Group 2, *Festuca rubra*,

Anthoxanthum odoratum, *Agrostis vulgaris*, *Briza media*, and *Alopecurus geniculatus*. Group 3, *Holcus lanatus*, *H. mollis*, *Bromus mollis*, *Agrostis canina*, and *Festuca ovina*. Group 4, *Molinia cœrulea*, *Aira cæspitosa*, *A. flexuosa*, *Sielingia decumbens*, *Nardus stricta*, and *Phragmites communis*.

The author has repeatedly tried the above method and considers it much more reliable than any other. The practical application of such an analysis the author considers under 6 heads: (1) Influence of fertilizers and differences between first and second cuttings; (2) a knowledge of the local differences in meadows as bearing on ameliorating conditions; (3) ability of different species to form aftermath, and variations in the same; (4) classification of grasses according to their ability to produce leaves and the causes which influence leaf development; (5) the determination of seed mixtures adapted to certain conditions, and (6) investigation of meadow plants according to their nutrient material, the valuation and duration of meadows and of the meadow land itself.

Contributions from the U. S. National Herbarium, J. N. Rose (*U. S. Dept. Agr., Division of Botany, Contributions from the U. S. National Herbarium, vol. I, No. 9, pp. 293–434, pls. 13, figs. 10*).—A report is given, containing critical notes and descriptions of new species, of a collection of plants made by E. Palmer in the States of Sonora and Colima, Mexico, during the years 1890 and 1891. The grasses were determined for this report by the late G. Vasey, the ferns by D. C. Eaton, the *Cyperaceæ* by N. L. Britton, the species of the genus *Piper* by C. de Candolle, the *Sapindaceæ* by L. Radlkofer, and assistance was given by others in various groups. An index of this completed volume is given in this number.

The influence of cold on plants—a résumé, C. Abbe.—In 1888 and 1891 Sebastiano Cavallero[1] published his original investigations confirming the results arrived at by German students a few years before as to the effect of frost upon plants. He states that until lately it was supposed that by the freezing of the sap the cells are distended and the tissues torn asunder, and that to this injury the death of the plant must be attributed. In the winter of 1887–'88 he ascertained that the frozen tissues did not suffer any injury, and repeated his observation in 1890–'91. He found that under the action of frost a rupture of the tissues is very rare and that the cells themselves never freeze; that the small crystals of ice are not formed within the cells, but in the intercellular spaces; and that this formation occurs both in the hardy and the delicate plants. It is the chemical changes brought about by frost that are of principal importance. So far as it goes Cavallero's work confirms that of Müller-Thurgau, published first in 1880, and subsequently elaborated and published in 1886. As his conclusions are not yet found in the textbooks, it may be stated that in general as the temperature of the plant

[1] Gior. Agr., 1888, Mar. 11; Gaz. Mantova, 1891, Jan. 24.

cools the water exuding from the individual cells leaves a more condensed sap behind and the intercellular spaces are filled with purer water. Owing to capillary phenomena this water is not easily frozen until it has been cooled several degrees below the freezing point, and then its temperature suddenly rises to 32° F., as in the ordinary experimentation of the physical laboratory. The water within the cells is of course not yet frozen, being a more condensed sap, whose freezing point is usually lower than that of pure water. If now the temperature falls still lower, the ice cools, and eventually the sap within the cells may be frozen, but this is rare, and when it happens it does not necessarily tear the cell wall, because the quantity within the cell is not more than sufficient to fill up the space formerly occupied by the water that exuded. If now the plant thaws out, the great mass of intercellular water escapes by transpiration. A little may go back into the cells, but this is a small percentage and oftentimes none. The plant wilts by the rapid loss of this water. Furthermore, a chemical change takes place in the cells by the excretion of pure water, and the cell sap that is left behind constitutes a new chemical compound. Such cells now change their character and their relation to the growth of the plant. Many of the excrescences and the diseases formerly supposed to be due to bacteria, or fungi, or parasites are found to be due to the chemical changes that have taken place within the cells in consequence of freezing. Thus Hartig shows that the frost *krebs*, or excrescence on trees, is a growth due to the effort of the plant to get rid of or cover up the dead cells produced by frost. When a frozen plant is young and tender and its leaves immature, the exudation through its tender cell walls may lie directly on the outside of the cuticle, but as the cuticle hardens in the mature plant, and the development of stomata becomes more complete, the greater part of the exuded water and its resulting ice is in the intercellular spaces. When the frozen plant is thawed out and evaporation is rapid the loss of water either from the surface of the tender plant or through the stomata of the mature plant is much more rapid than under normal conditions and the plant wilts, but when there is no evaporation, the sap has time to return into the cells, and the wilting is not so severe. Therefore it is proper to say that the injury is not done by the more or less rapid thawing, but by the more or less rapid evaporation that accompanies the thawing. If similar plants are thawed out under warm and cold water, respectively, the rate of thawing has no influence on its health, as was shown by Sachs long ago. It is now seen that this is because in both these cases there is no special chance for evaporation, and the sap was able to go back into the cells; the contrary occurs when the plant thaws in the open air.

It is commonly said that those plants and parts of plants which catch the early morning sun and are thawed out rapidly suffer in consequence, but it is now evident that two other factors have a predominating influence, viz, (1) the special evaporation in air and sunshine;

(2) the fact that these parts have, during the previous growth, been daily receiving extra sunshine and have thereby become more turgescent than the shaded portions. This has prepared their cells to suffer more from frost. Kunisch likens the chemical change that the sap undergoes in each cell to the freezing out of cryolites at specific temperatures from ordinary solutions; it is the chemical change that is the real cause of the death of the cells, and if too many cells are killed the whole plant succumbs. Moll shows that the wilting of the frozen leaves is due to the collapse of the cells whose exuded water has frozen in the intercellular spaces.

Sorauer traces the frost *brand* or blight, the frost *krebs* or cancer, the frost *beulen* or boils, the frost *leppen* or patches, and the frost *runzeln* or wrinkles and puckers to a healthy effort of the plant to get rid of or cover up the cells that have been killed by the frost. When a plant is abundantly supplied with warmth and moisture it suffers most from spring frosts; but when it has been retarded in its development, and especially when it is still in its winter stage of vegetative repose, it suffers least. When the autumn and early winter are warm and dry and the tree continues its growth late in the season the subsequent winter freezes are more injurious to it because in general there is more sap in its cells and more cells suffer from the chemical changes produced by the cold. R. Goethe collects a number of facts illustrating this general principle. He recommends that all frost wounds be cut out as soon as perceived and closed up with grafting wax; covering the wounds with clay may sometimes do, but in general fungi develop beneath that. The hot wax or wash with fungicides may kill the wood to the depth of a millimeter, but it preserves the rest. Goethe recommends to strip off the leaves in autumn, to loosen the earth about the roots, to whitewash the branches and trunks with lime and envelop them with straw. Sorauer has especially investigated both the mechanical and chemical injuries and the effects of temporary frosts and of long-continued freezes. Müller-Thurgau in 1886 summed up the experience of others and the thousands of experiments made by himself about as follows: The exudation of the sap from the cells and its freezing outside is the death process. Then the injury is done, the cell is dead from that time forth, but perhaps not the whole plant; no process of thawing will revive the dead cell or dead plant. As a protection against loss by frost he suggests: The proper selection of varieties which, in consequence of their origin, can be considered as able to resist frost; the new development of hardy varieties from such hardy individuals as may be occasionally discovered; the diminution of danger against frost by proper cultivation and nourishment and whatever makes the plant sound and vigorous, as suggested by the various experiences of severe winters; the acceleration of the beginning of the period of vegetative rest (stripping the leaves is considered to be without advantage) and the retardation of development—that is

to say, the prolongation of this repose by protecting the plants and the soil from premature warmth. As external protections, he recommends covering the ground around the plants with earth or snow or mulching. He gives special attention to the smudging of the vineyards, with some historical details. We must refer to the original[1] for the many details which he gives as to the treatment of plants that have been injured by frost.

Since 1886 the following additions to our knowledge have been published. In 1886 Wollny[2] summarized our knowledge of methods of cultivation by which to assist cultivated plants in overcoming unfavorable climatic influences, especially frost. He lays principal stress upon the introduction of hardy varieties and shows that these may be developed by selecting the larger seeds. In general the plant has a greater resistance to frost in proportion as the seed from which it was developed is larger. Again, plants from unripe seeds possess a less resisting power to the frost than those from the developed seed. Again, a seed that develops prematurely in the fall has the greatest danger of suffering during the following winter. Finally, the plants stand the frost better in proportion as the seed is buried less deeply, since the seeds that are sown shallow give rise to the most vigorous plants.

Detmer[3] finds that perfectly dry grains and fruits exposed to -10° C. or lower retain their vitality, but that moist fruits and seeds are killed. Ordinary wheat kept at -10° C. loses much of its energy and speed of growth and is enfeebled apparently in proportion to its moistness. He agrees with Sachs that many plants die under rapid thawing that live under slow thawing, but that certain parts of plants die in consequence of freezing alone independently of thawing.

Kny[4] from his experiments as to whether frost acting on the seeds affected the subsequent development of the plant found that seeds of peas, beans, clover, rape, tobacco, and barley, when they were well dried and then divided into 3 groups, (1) those that were frosted, (2) kept cool, and (3) quite warm, and then planted, germinated and developed without any great difference; but seeds that were not well dried were injured by the cold.

Wollny[5] finds that potatoes are less in number and weight when the seed tubers have been long exposed to freezing.

L. H. Bailey,[6] has shown the good influence of wind-breaks in agriculture, including their advantages as a protection against freezing.

Jumelle[7] shows that although plants cease respiring at very low

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[1] Landw. Jahrb., 15 (1886), pp. 453–609.

[2] Forsch. Geb. agr. Phys., 9 (1886), p. 292.

[3] Ibid., 10 (1888), p. 235. [4] Ibid., 11 (1888), p. 122. [5] Ibid., 12 (1889), p. 398.

[6] N. Y. Cornell Sta. Bul. 9 (E. S. R., 1, p. 276).

[7] Forsch. Geb. agr. Phys., 14 (1891), p. 445.

temperatures, yet in the presence of light they can assimilate the carbonic acid gas of the atmosphere at a temperature of −40° C., and that the so-called sleep, or vegetative repose, is due to the drying up of the plant and not to the cold.

Bliznine[1] shows that the freezing of wheat in a cold but snowless December does much more injury than in February, apparently owing to the early tender stage of growth.

Hartig[2] shows that the temperature under the bark of a tree after the leaves have fallen, and therefore in winter time, may be 50 or 55° C. on the sunny side, while the temperature on the shady side is 15 or 20° less. With this high temperature there comes a stimulated evaporation on the sunny side that separates the bark and kills the tree.

Petit[3] calls attention to the fact that as water in capillary vessels does not freeze until it is cooled down to a temperature far below that of melting ice, so in like manner the water in the soil which is spread in capillary films over each grain of gravel may be cooled to about 15° F. without freezing, but when it does change to ice it suddenly warms up to 32°. For this reason the temperature of the soil cools more rapidly during the nighttime in proportion as the soil is drier. On the contrary, in the summer time, when freezing does not come into play, the soil is warmer in proportion as it is drier.

Prunet[4] finds that on thawing the frozen plant the water is lost by evaporation from the surface rather than by the ordinary operation of transpiration through the stomata or breathing pores.

Schindler[5] in his extensive special studies on the relation of wheat to climate accepts the fact that wheat is less sensitive to frost in proportion as its vegetative period is longer, but thinks that no explanation is as yet known. The dry wheat of the Steppes does better than the moist wheat of western Europe. The power of resisting frost depends ultimately on the specific peculiarities of the protoplasm, about which we know nothing.

The effect of bad seasons on the growth of trees, A. CARY (*Garden and Forest, 8 (1895), pp. 88, 89*).—During the winter of 1893–'94 the author made a study of the so-called year rings of spruce trees, in the course of which the rings of over 1,400 trees in Maine were counted. In all trees of apparently more than 80 years' growth a belt was noticed in which the rings were greatly reduced in size, in some cases being seen only with the aid of a microscope. By reference to meteorological data of undoubted authority it was learned that a series of remarkably cold seasons began in 1812 and culminated in 1816, the years 1812, 1815, and 1816 being the most severe. The record of the effect of these years

[1] Forsch. Geb. agr. Phys., 15 (1892), p. 122.
[2] Ibid., 16 (1893), p. 64.
[3] Ibid., p. 285.
[4] Ibid., 17 (1894), p. 142.
[5] Ibid., p. 209.

in the trees is usually represented by a zone of 6 or 7 greatly reduced rings. If each ring represents a year's growth the zone should begin with the seventy-seventh from the bark. In some cases this was found to be true, but more frequently there was a discrepancy of 3 or 4 rings. Counting from the inside of the zone of reduced rings to the bark a similar discrepancy is noted, showing that the number of rings can not be taken as a perfect index of the age of a tree, but shows the number of growth periods, which may be influenced by cold or drought, in which case several rings may be deposited during a single year, or in ordinary seasons an occasional extra ring may be deposited.

The paths of gaseous exchange between the aërial leaves and the atmosphere, F. F. BLACKMAN (*Proc. Roy. Soc., 57 (1895), No. 342, pp. 165–168*).—On account of the smallness of the quantities of gas involved, the author states that practically no attempt has been made hitherto to determine by direct estimation the question of the path by which carbonic acid passes out of the leaf in respiration and into it in assimilation—whether this takes place by the stomatal openings or through the continuous surface of the cuticle. The existing experimental evidence is all of an indirect nature, and rather tends to support the view that the exchange is a cuticular phenomenon. Barthélemy in 1868 put forth the view that the cuticle was especially adapted for transmitting carbon dioxid from the external air to the assimilating cells beneath. This view he supported by experiments on the artificial osmosis of gasses through leaves. About the same time Boussingault performed experiments that seemed to show definitely that in assimilation the carbon dioxid taken up by the leaf entered it through the upper surface devoid of stomata rather than through the more distant stomatal openings. In support of the view that stomata form the paths of gaseous exchange we have the conclusion arrived at by Mangin in 1888, from diffusion experiments on isolated cuticle, that this diffusion is insufficient to account for the whole gaseous exchange of the leaf. By the aid of an apparatus designed by the author he has been able to estimate successfully the amount of carbon dioxid given out and taken in by the two surfaces of the same leaf under the same conditions. For this purpose shallow capsules 10 sq. cm. in area, consisting of a glass plate with metal rim, through which tubes for the circulation of the air current pass, are employed. Two of them are affixed to a leaf on opposite sides of the same area in air-tight union by means of soft wax. Through these two continuous currents of air can be kept flowing over the two surfaces and the carbon dioxid produced or taken in during a given time by each of them be determined. Numerous experiments on the respiration of a variety of leaves with the stomata all on one side or variously distributed on the two sides agree in showing that the stomata are the site of the exhalation of this gas. When no stomata are present on the upper surface of the leaf then practically no carbon dioxid is exhaled from that surface, while more than thirty times as

much may be given off from the lower stomatiferous surface. When stomata occur on both surfaces the relative amounts of the gas exhaled closely follow the ratios of the number of stomata. To prove this the author shows that *Ampelopsis hederacea*, with no stomata on the upper surface, but with many on the lower, exhales carbon dioxid in the proportion of 3:100 for the two sides; in *Alisma plantago* the proportion of the stomata on the two surfaces is as 135:100, and the proportion of the gas exhaled is as 120:100; in *Iris germanica*, with an equal number of stomata on each surface, the proportion of the gas exhaled by the two surfaces is as 110:100; and in *Ricinus communis* the proportion of stomata is as 100:250, and the gas exhaled is as 100:260.

Experiments in the absorption of carbon dioxid during assimilation showed the same close relation to the distribution of stomata. As hitherto carried out, the author considers direct sunshine, continuous for several hours, as essential to the success of these experiments. A very simple experiment of the author's will show that the stomata are practically the sole path of entry of carbon dioxid for assimilation. If part of the lower stomatic surface of any leaf, having no stomata on its upper surface, be coated with wax so as to mechanically block the stomata, no starch can be formed in that area, while adjacent areas may become rich in starch.

The previously mentioned experiments by Boussingault were conducted with the leaves of *Nerium oleander*, the upper surface of whose leaves possesses no stomata. These leaves assimilated less when the upper surface had been coated with wax than when the lower stomatiferous surface had been so coated. The author claims that the explanation of this is due to the fact that Boussingault experimented with the leaves in an atmosphere containing 30 per cent of carbon dioxid, which is greatly in excess of the optimum percentage of carbon dioxid assimilated by this leaf. Under these conditions there penetrates into the leaf so much of the gas that its assimilatory activity is lessened and falls below that of another leaf, into which, owing to the blocking of the stomata, the gas diffuses very slowly and can not exceed the optimum strength.

Further evidence on the possible paths of gaseous exchange has been obtained by investigating the degree to which diffusion of carbon dioxid can be artificially produced through the living leaf. Strong mixtures of the gas were led continuously across one surface of the leaf and the amount which diffused through it was estimated. Other experiments on the respiration of injected leaves also support the view that the stomatal openings, in spite of their minuteness, offer a much easier path from the atmosphere to the interior of the leaf than does the cuticle. The conclusions of the author are as follows:

"(1) Under normal conditions practically the sole pathway for carbon dioxid into or out of the leaf is by the stomata. Since oxygen diffuses more readily than carbon dioxid through fine openings, the same probably holds for oxygen and the whole of the gas exchange.

"(2) Under abnormal conditions, when the stomata or intercellular spaces are blocked and the surrounding tension of carbon dioxid is great enough, passage of carbon dioxid by osmosis through the cuticle may take place.

"(3) That such closure of stomata as is held to take place in darkness does not prevent the distribution of gas exchange closely agreeing with that of the stomata.

"(4) That the exhalation of carbon dioxid in bright light by a leafy shoot in Garreau's well-known experiment is not the expression of any physiological truth for the leaf, but only due to the imperfections of the conditions; to the presence of immature parts, or of tissues not sufficiently green or not fully illuminated. Mature isolated green leaves fully illuminated assimilate the whole of their respiratory carbon dioxid and allow none to escape from them."

The bacteria of the root tubercles of Leguminosæ, M. GONNERMANN (*Landw. Jahrb., 23 (1894), No. 4 and 5, pp. 649–671*).—The author has sought by means of pure cultures, soil investigations, and inoculation experiments to ascertain the probable number of forms of bacteria capable of forming tubercles on the roots of leguminous plants. The methods employed by the author are described very minutely. Plate, gelatin, and potato cultures were made of all forms found in the tubercles of *Lupinus albus*, *L. angustifolius*, and *L. luteus*, and the winter soil was carefully examined to learn how the organism passes the winter. He found in his cultures several forms of *Bacillus* and *Micrococcus*, and claims that those bacteria forming tubercles on the roots of legumes are spore forming, and in this way pass the winter in the soil.

From his experiments the author thinks that there is not so great a necessity for the presence of bacteria for nitrogen assimilation as is sometimes claimed, and that the relationship between the plant and the organism is often one of parasitism rather than of symbiosis.

The author concludes that (1) the tubercles of *Leguminosæ* are not formed by a single specific bacterium, but that in different localities are to be found different organisms capable of producing them; (2) the Y-formed specimens, the so-called bacteroids, are very complex while in symbiosis with the plant, but later upon the dissolution of the tubercles they separate into simple bacilli, and as such they may be found in the surrounding soil. In the spring they enter the plants and form by their growth into new Y-shaped bodies; (3) the symbiotic relationship is not yet completely established, since the tubercle bacteria alone can not make the free nitrogen available for the plant, but it seems more probable that the plant itself without symbiosis can take up and assimilate free nitrogen; the bacteria, however, may assist the plant in contributing to its higher nitrogen content. Further, it is shown that in spite of the presence of bacteria the plants do not take up any greater nitrogen content. From many recent experiments it is shown that not only a symbiotic but also a parasitic relationship exists between the plants and their bacteria, also that the effect of the bacteria and the method of nitrogen assimilation are not well known.

On the presence of alumina in plants and its distribution, BERTHELOT and G. ANDRÉ (*Compt. Rend., 120 (1895), No. 6, pp. 288–290*).—As a contribution to the question of the existence and proportion of alumina in plants the following determinations, among other data,

are reported: Carefully washed alfalfa roots, 0.127 to 0.5 per cent of pure alumina; convolvulus roots, 0.0596 to 0.4 per cent; Bermuda grass roots, 0.011 to 0.12 per cent; lupine leaves, 0.013 to 0.037 per cent; linden leaves, 0.0012 to 0.0025 per cent.

These results indicate that alumina is present in considerable amounts in plants with extensive root systems, but that it remains largely in the roots and is found in only minute quantities in the leaves.

Report of the botanist, B. D. HALSTED (*New Jersey Stas. Rpt. 1893, pp. 289–436, figs. 73*).

Synopsis.—The author gives a report on weeds, potatoes grown directly from the cuttings, the solandi process of sun printing, and various fungus diseases (see p. 823).

Report on weeds (pp. 290–312).—The author prepared as a part of the Agricultural College and Experiment Station exhibit at the Columbian Exposition a collection of the most common weeds of the country, which were displayed in wing frames and as an herbarium. A case of 100 weed seeds was also shown. In collecting the material for this exhibit an opportunity was offered for extending the check list of American weeds, a revised list of which is given. This list embraces 817 species, representing 77 orders. An illustrated lecture upon weeds was prepared, a synopsis of which is given.

Potatoes by the direct method (pp. 312–318).—The author's attention was called to specimens of seed potatoes that failed to produce plants. In their stead small tubers were grown from the eyes, and all further development stopped. In a few cases there was a feeble attempt to send up shoots, but in all cases the yield was greatly reduced. Foreign truckers are said to sometimes take advantage of this habit to produce an early crop of potatoes. The reason for this unusual behavior seems to be physiological, and whatever tends to weaken the seed may under adverse atmospheric conditions produce the result given above.

The solandi process of sun printing (pp. 318–323).—This process consists in exposing the subject, necessarily somewhat translucent, to the sunlight in an ordinary printing frame with a sheet of sensitized paper back of it, as in the ordinary way of printing from a negative. This sun print when toned becomes the negative from which the pictures may be printed, a piece of glass being interposed between negative and print. The toning is done with kerosene for both negative and positive. As the object must be translucent, the uses to which this method can be placed are limited, but any object that will allow any light to penetrate may be so photographed if exposed long enough. Leaves, thin sections of wood, rusts, leaf spots, blights, etc., are especially adapted to this process. This method of printing is not new, but the use of kerosene as a clarifying agent is the chief point of interest, as it diminishes the time required for exposure and sharpens the details of the positive picture.

Shrinkage of leaves in drying (pp. 323–326).—Numerous leaves were printed by the solandi process, after which they were prepared for the

herbarium in the usual way. A table is given showing that endogens shrink less than exogens, the average of 4 endogens being 18 per cent, with 11 per cent for *Pontederia* and 27 per cent for a *Panicum*, while the average of 7 exogens was 31 per cent in drying, the extremes being 21 per cent for hollyhock and 45 for a catalpa leaf. A study of the outlines shows that leaves shrink most in the region of fewest veins, and the author gives the following law: "Leaves in drying under pressure shrink toward the mass center of their framework."

Botanical work at the Mississippi Station (*Mississippi Sta. Rpt. 1893, p. 47*).—A brief mention of the nature of the botanical work being carried on at the station, which is chiefly devoted to a botanical survey of the State, comprising a collection and study of the flowering plants, and also of the mildews, rusts, smuts, and other parasitic fungi.

A model for a botanical course, G. HABERLANDT (*Bot. Centbl., 61 (1895), No. 7, pp. 241, 242*).

On the list of Pteridophyta and Spermophyta of northeastern America as prepared by the nomenclature committee of the Botanical Club, B. L. ROBINSON (*Bot. Gaz., 20 (1895), No. 3, pp. 97-103*).—The author gives numerous instances in which the rules of the committee do not secure the much desired stability of nomenclature, and advances opinions why their rules will not secure the desired results.

The fundamental difference between plants and animals, C. S. MINOT (*Science, n. ser., 1 (1895), No. 12, pp. 311, 312*).—The author holds that plants obtain their food, either liquid or gaseous, by osmosis; and animals in the form of concrete particles which are lodged in the cell protoplasm by the activity of the protoplasm itself. Apparent discrepancies are offered in the case of the Myxomycetes and the tape worm, the one usually classed with plants taking its food by an amœba-like method, the other living as a parasite by absorption.

The plant individual in the light of evolution, L. H. BAILEY (*Science, n. ser., 1 (1895), No. 11, pp. 281–292*).—The author discusses bud variation in its relation to Weismannism. He considers the theory of Weismann inadequate to explain bud variation.

What constitutes metamorphosis in botany, A. MANN (*Inaug. Dissertation, Munich, 1894, pp. 40, figs. 25; abs. in Bot. Centbl., 61 (1895), No. 7, pp. 264, 265*).—The author discusses the morphology of sprouts, (*a*) tendrils, (*b*) thorns, and of leaves, (*a*) bud scales, (*b*) phyllodia, (*c*) tendrils, and (*d*) thorns.

The geotropic curving of nodes, R. BARTH (*Inaug. Dissertation, Leipzig, 1894, pp. 39; abs. in Bot. Centbl., 61 (1895), No. 10, pp. 364, 365*).

Contraction of trees caused by cold, J. CLAYTON (*Nature, 51 (1895), p. 462*).—The author gives measurements of 13 trees measured October, 1894, and February and March, 1895, showing a contraction for February, when the temperature was 3° F., varying from $\frac{2}{16}$ to $\frac{6}{16}$ of an inch in circumference.

On the forms of chlorophyll, A. ETARD (*Compt. Rend., 120 (1895), No. 6, pp. 328–331*).—The author has separated from afalfa a second form of chlorophyll, the formula of which is $C_{42}H_{63}NO_{14}$.

On the forms of chlorophyll, A. GAUTIER (*Compt. Rend., 120 (1895), No. 7, pp. 355, 356*).—Remarks on articles by Etard (*Compt. Rend., 119 (1894), p. 219, and 120 (1895), p. 328*). The author states that he (Gautier) showed in 1877 that there were different kinds of chlorophyll in different orders and genera of plants. He had separated the principal chlorophyll of rye grass and spinach in 1886, the formulas for which are given as $C_{30}H_{48}N_2O_3$ for the rye grass, and $C_{40}H_{64}N_2O_4$ for the spinach.

A preliminary investigation of the presence of diastase in plants, J. GRUSS (*Ber. deut. bot. Ges., 13 (1895), No. 1, pp. 2–14*).

Root tubercle bacteria, DANCKELMANN (*Ztschr. Forst. und Jagdw., 27 (1895), No. 2, pp. 90, 91*).

Do plants assimilate argon? E. BLASS (*Nature, 51 (1895), p. 461*).—The note by Blass is answered by W. Ramsey, one of the discoverers of the new element, that experiments are under way by which the question can be answered.

Primitive corn (*Meehan's Monthly, 5 (1895), No. 3, p. 44, fig. 1*).—An account of sexual abnormalism in an ear of corn—the pistillate and staminate flowers mixed.

A new method for investigating the carbonic acid gas exchanges of plants, F. F. BLACKMAN (*Proc. Roy. Soc., 57 (1895), No. 342, pp. 162–164*).—An abstract is given briefly describing a form of apparatus designed to measure small quantities of carbonic acid gas given off by parts of leaves.

Apparatus for physiological botany, W. C. STEVENS (*Bot. Gaz., 20 (1895), No. 3, pp. 89–96, pls. 4*).—Descriptions are given of a centrifugal machine and three forms of clinostats—a horizontal, vertical, and universal clinostat.

Flowers and Insects, XIII, C. ROBERTSON (*Bot. Gaz., 20 (1895), No. 3, pp. 104–110*).—The author discusses the mutual relationship between the flowers of *Dodecatheon meadia, Steironema ciliata,* and *Euslenia albida,* and the insects found to visit them.

Phenological observations in Metz during the years 1891–'94, SCHÄFER (*Jahresber. Ver. Erdkunde in Metz, 16 (1893–'94)*.

ZOÖLOGY.

Monographic revision of the pocket gophers, family Geomyidæ, C. H. MERRIAM (*U. S. Dept. Agr., Division of Ornithology and Mammalogy, North American Fauna, No. 8, pp. 258, figs. 71, pls. 20, maps 4*).—An illustrated monograph of the pocket gophers, exclusive of the genus *Thomomys*, giving detailed technical, anatomical, and systematic descriptions of the various species, with notes on habits. It is divided into introduction, and 4 chapters: General remarks; morphology of the skull; the dental armature, comprising the teeth and the mechanism and dynamics of the cutting machine; and systematic descriptions of the genera and species. The genera *Pappogeomys*, *Cratogeomys*, *Platygeomys*, *Orthogeomys*, *Heterogeomys*, *Macrogeomys*, and *Zygogeomys*, and the following species and subspecies are described as new: *Geomys tuza mobilensis*, *G. breviceps sagittalis*, *G. breviceps attwateri*, *G. texensis*, *G. arenarius*, *G. personatus fallax*, *Pappogeomys albinasus*, *Cratogeomys perotensis*, *C. estor*, *C. peregrinus*, *C. oreocetes*, *C. castanops goldmani*, *C. fulvescens*, *Platygeomys tylorhinus*, *P. planiceps*, *Orthogeomys latifrons*, *O. nelsoni*, *Heterogeomys torridus*, *Macrogeomys dolichocephalus*, *M. costaricensis*, and *Zygogeomys trichopus*.

Pocket gophers and moles, C. L. NEWMAN (*Arkansas Sta. Rpt. 1894, pp. 108–113*).—A reprint from Bulletin 28 of the station (E. S. R., 6, p. 389).

METEOROLOGY.

Frost warnings, J. M. SHIRIER (*Proc. Ga. Hort. Soc. 1892, pp. 56–58*).—Brief general note on Georgia weather service and the methods of sending out information as to the approach of frosts. It is recommended that smudges be used for protecting plants from early frosts. Piles of slowly inflammable material, such as green pine butts, are to be made and lighted, at least 4 smudge piles being employed for every 160 acres of ground. It is believed the smudge would be dense enough to envelop surrounding vegetation and protect it from frost, as is done successfully on the prairie lands of Minnesota.

Prediction of night frosts in the spring, C. Rousseau (*Rev. Hort., 67 (1895), No. 3, pp. 71–74*).—The results of observations from March 20 to May 20 during the years 1880–'94 are reported, showing that the average difference between the reading of the wet-bulb thermometer during the afternoon and the minimum thermometer the following night was 4.8° C., thus in a measure confirming the accuracy of Hammermann's statement that frost may be expected if the reading of the wet-bulb thermometer in the afternoon minus 4° is 0 or less. A closer analysis of the results, however, shows that this factor is by no means constant, but depends largely upon direction of the wind, cloudiness, rainfall, etc.

The use of a somewhat larger factor than 4° is recommended as generally safer in practice. In fair weather, with the wind north or northeast, the difference is nearer 7 or 8 than 4°.

Meteorological observations at Berkeley, California, L. E. Hunt (*California Sta. Rpt. 1893 and 1894, p. 362*).—A synopsis of observations for 7 years ending June 30, 1894, on air pressure, temperature, precipitation, humidity, cloudiness, and direction of wind. The summary for the year ending June 30, 1894, is as follows: *Pressure* (inches).—Mean, 30.059; highest, 30.410 (Dec. 28); lowest, 29.682 (Feb. 12); yearly range, 0.758; highest monthly average, 30.183 (December); lowest monthly average, 29.921 (August). *Temperature* (°F.).—Mean of the year, 50.2; mean of the warmest month, 59 (July); mean of the coldest month, 44.2 (January); maximum, 79.5 (April 19); minimum, 31 (January 6); yearly range, 48.5; greatest monthly variation, 40 (April); least monthly variation, 25 (September); mean daily range, 14.4; mean lowest, 47.7; mean highest, 62.1. *Precipitation* (inches).—Total rainfall, 26.650; dew and fog, 0.084. *Humidity.*—Mean relative, 82.8; greatest monthly variation, 52 (November); least monthly variation, 26 (August); maximum, 97 (November 24, 8 a. m.); minimum, 45 (November 17, 8 a. m.); yearly range, 52. *Weather.*—Number of clear days, 163; number of fair days, 93; number of cloudy days, 109; number of foggy days, 107; number of days on which rain fell, 68. *Wind.*—Prevailing direction, southerly.

Report of meteorologist, W. H. Bishop (*Delaware Sta. Rpt. 1893, pp. 203–217*).—Monthly summaries of observations at 6 stations in the State on temperature, pressure, and rainfall are given. A summary of temperature and rainfall observations for the year 1893 is given in the following table:

Annual summary of meteorological observations in Delaware.

	Newark.	Middletown.	Dover.	Milford.	Seaford.	Millsboro.
Temperature (°F):						
Highest	97.00	96.00	101.00	95.00	97.00	97.00
Lowest	— 9.00	— 5.00	— 6.00	— 9.00	— 5.50	— 17.00
Mean	50.90	51.30	52.50	53.80	53.60	53.50
Rainfall (inches), total	36.29	41.15	42.10	40.45	40.62	44.02
Number of days on which 0.01 inch or more of rain fell	87	91	92	94	89	101

The mean temperature was slightly lower than for the past 3 years. The hottest days were June 20 and July 26, the difference in temperature between the two being very slight. The coldest day was January 17. The rainfall for the year is slightly below the average, the greatest deficiency occurring in June. Damaging storms occurred August 23 and 24 and October 13 and 14. The first killing frost occurred October 17.

Meteorological summary (*Mississippi Sta. Rpt. 1893, p. 62*).—The results of observations during 5 years (1889–'93) on temperature and rainfall are tabulated. The following summary is taken from the tables reported:

Meteorological summary for Mississippi, 1889–'93.

	1889.	1890.	1891.	1892.	1893.
Temperature (°F.):					
Maximum	97.00	96.00	97.00	96.00	[1] 99.00
Minimum	15.00	19.00	19.00	13.00	[2] 9.00
Mean	62.90	64.90	63.60	62.50	62.90
Rainfall (inches)	44.96	55.05	61.17	59.78	40.17
Number of rainy days	78	94	84	101	86

[1] July. [2] January.

The average yearly rainfall for the 5 years was 52.23 in., the highest average monthly rainfall being 7.11 in. in July, the lowest 1.03 in. in October.

Protection from night frosts, S. LEMSTRÖM (*U. S. Patent No. 525989, Sept. 11, 1894*).—An account of the method of protection for which this patent is issued has already been noted (E. S. R., 5, p. 660).

Meteorology (*Arkansas Sta. Rpt. 1894, pp. 51, 52*).—A reprint from Bulletin 26 of the station (E. S. R., 5, p. 1070).

Meterological observations at Newport and Camden, Arkansas, G. B. IRBY and F. H. CLARKE (*Arkansas Sta. Rpt. 1894, pp. 86, 114*).—Daily summaries, April to October, 1893, of temperature and rainfall observations at Newport and summaries of similar observations for each month of 1893 at Camden.

Monthly Weather Review (*U. S. Dept. Agr., Weather Bureau, Monthly Weather Review, 22 (1894), Nos. 7 and 8, pp. 273–350; charts 8*).—These numbers are devoted to the usual topics.

Periods in temperature, H. A. HAZEN (*Amer. Met. Jour., 11 (1895), No. 11, pp. 416–418, dgm. 1*).—Summations of temperature fluctuations over the whole United States during 27-day periods in the 9 colder months of the year are projected in a diagram. "There is absolutely no period established in these cases."

The occurrence of cold days (*Nature, 51 (1895), No. 1322, pp. 416, 417*).—The maxima for 50 winters at Greenwich are tabulated and discussed and maxima not over 32° F. are charted.

New relations between the movements of the barometer on the northern hemisphere and the movement in declination of the sun and moon, P. GARRIGON-LAGRANGE (*Compt. Rend., 120 (1895), No. 6, pp. 342, 343*).

Variations in the rainfall in European Russia, E. A. HEINZ (*Bul. Acad. Imp. Sci., St. Petersburg, ser. 5, vol. 2, No. 1, pp. 49–54, pls. 2*).

Harrington's rainfall charts—a review (*Science, n. ser., 1 (1895), No. 12, p. 319*).

A new form of barometer, J. N. COLLIE (*Jour. Chem. Soc. London, 1895, Feb., pp. 128–132, fig. 1*).

WATER—SOILS.

The cienegas of southern California,[1] E. W. HILGARD (*California Sta. Rpt. 1893 and 1894, pp. 185–188*).—"A *cienega*, in the parlance of the native Californian, is a limited area showing a growth of water-loving plants, appearing sporadically in otherwise arid surroundings—usually hillsides or valley margins—and occasionally giving rise to flowing springs." The cienegas of the San Antonio, Santa Ana, and Mill creeks, and of the Temescal Valley, are described and their value as sources of water supply discussed.

"While they do not render the establishment of artificial storage reservoirs superfluous, they do supplement them locally to a very material extent, rendering it possible to occupy for agriculture large areas that otherwise would have remained arid for many years to come.

"But there arises the question as to the geographical limits within which these natural storage reservoirs may reasonably be sought, for it is notorious that they are not usually found, and the name and idea of the cienega is not generally known in the northern portions of California.

"The essential condition of cienega formation is manifestly the opportunity for the abundant formation of deposits of exceptionally coarse and pervious gravel and cobbles near the points where the canyons emerge from the mountains. This, again, is necessarily conditioned upon the occasional occurrence of violent, torrential rainfall in the mountains, alternating with periods when quiet deposition allows of the formation of water-shedding layers. Another condition appears to be the ready weathering of the parent rocks into rounded forms, by which close packing is prevented, so that abundant interspaces are permanently maintained. Both conditions are fulfilled to an unusual extent in the granitic ranges of southern California."

Investigations in soil physics, R. H. LOUGHRIDGE (*California Sta. Rpt. 1893 and 1894, pp. 70–100, dgms. 2*).—The results of examinations of a large number of different soils made at intervals during the past 15 years at the California Station are summarized in this article, "in order to draw as far as possible some conclusions, either positive or negative, as to the relation of the various sediments or ingredients to the power possessed by soils to absorb hygroscopic moisture, to their capacity for holding water, and to their power of transmitting water by capillarity." A somewhat detailed discussion is given of the influence of physical constitution and chemical composition of the soil on its hygroscopicity, especial attention being given to the influence exerted by clay; the methods and results of studies of the water-holding capacity of different soils, and the rapidity, height, and extent of the capillary rise of water in soils of different character subjected to different treatment.

The general conclusions drawn are as follows:

"(1) The power possessed by soils of absorbing moisture from the atmosphere and to hold water within their pores is not proportionate alone to the amount of combined surface presented by the particles of the soil; and while, as a very general class, soils with large percentages of clay and fine silts have a high moisture and water capacity coefficient, such materials by no means control that power, simply

[1] Read at the meeting of the Geological Society of America at Washington, August, 1891.

because of large surface area; for even in the small number of soils represented in the above analyses there are many which, though having very high clay percentages, are low in their moisture and water coefficient, and *vice versa.*

"(2) There are in the soil certain chemical compounds (zeolites, ferric, silicic, and aluminic hydrates and humic compounds), which are highly hygroscopic and absorptive in themselves, and are held almost exclusively by the clay in greater or less amounts. The proportion of these, singly or conjointly, seems to have a greater, if not a controlling, influence over that power than the mere amount of clay and fine material, as such.

"(3) The upward movement of water in soils is controlled in rapidity by the proportion of coarse material; and the limit in height to which water will rise by capillarity is dependent upon the amount of fine silt and clay. The extreme height reached thus far, under the most favorable conditions, is 50 in., even after several months. In sandy soils the limit was less than 18 in.

"(4) The presence of alkaline salts in a soil produces a puddling or deflocculation of the particles when wet, and a consequent compact condition, which prevents the rapid rise of water. This puddling is accompanied by large contraction of volume, a feature which to a far less degree has been observed in other soils. On the other hand there are some soils (adobes and certain ferruginous clays), which, when wet, expand quite considerably, because of the swelling of the colloidal particles.

The amount and kind of soluble salts present in different portions of an alkali spot, from the center to the circumference, C. COLEMORE and E. W. HILGARD (*California Sta. Rpt. 1893 and 1894, pp. 140–145*).—Tabular statements of analyses showing the amount and composition of the alkali salts taken at 5 different distances from the center of an alkali spot are reported and discussed. It was observed that there was a more or less regular decrease in the amount of the alkali salts toward the margin, beyond which normal vegetation would thrive. In this case the maximum amount "found to be compatible with ordinary (weed) vegetation was 0.23 per cent, or a little less than a quarter of 1 per cent of total soluble salts, of which, however, one third was carbonate of soda and nearly another third common salt, or nearly 0.08 per cent of the soil of each." It has been observed, however, that this amount of carbonate of soda in an adobe soil is sufficient to prevent the growth of any useful plant. "It is therefore obvious that the mere determination of the amount of total salts present in a soil is not sufficient to determine its fitness or unfitness for crop growth. It is essential that the nature and proportion of the different salts present should be determined before a definite judgment can be had."

The analyses show further that the alkali containing the highest amount of carbonate of soda also contained the largest proportion of organic matter; that the per cent of soda steadily increased from the margin toward the center, while the reverse was true for potash; that carbonic acid and phosphate increased from the circumference toward the center; that chlorin decreased from the margin toward the center, while the proportion of nitrates was greatest at a point about halfway between the margin and center.

Reclamation of alkali land with gypsum at the Tulare Station, C. H. SHINN and E. W. HILGARD (*California Sta. Rpt. 1893 and 1894,*

pp. 145–149, pls. 3).—This is an account of a continuation of experiments described in the Report of the Station for 1891–'92, pp. 80–'90 (E. S. R., 5, p. 569), the treatment tried in the earlier experiments on a small scale ($\frac{1}{4}$-acre plat) on underdrained soil being extended to a larger area ($\frac{3}{4}$ acre), which had not been underdrained, but had had the hardpan broken up by blasting.

"The total amount of gypsum used upon the acre now under treatment is 3,000 lbs. Only 625 lbs. has gone on the first one fourth acre, which was underdrained. This was at the rate of $1\frac{1}{4}$ tons to the acre. The plats on which blasting powder was used have required 2,375 lbs. of gypsum, or at the rate of nearly 3,200 lbs. to the acre, and are not yet as far reclaimed as the first plat. They will probably require half a ton more to yield wheat and barley at the rate of last year's crop on the smaller plat. The gypsum is evidently distributed more evenly and therefore more effectively by the method of underdraining, where the conditions are similar to those that prevail at the Tulare Station. . . .

"The cultures attempted in the spring of 1892 were more varied than before, embracing beets, corn, sorghum, cereals, grasses, clovers, and some garden crops. Most of these were sown in short rows near the middle of the plat, and the rows received a special application of gypsum to better protect the seed. Results showed the effect of the underdrains; the nearer the plants stood to the line of a drain the better they grew. While many cultures failed entirely, there was much to encourage hopefulness. Sorghum and Egyptian corn in some cases grew 6 or 7 ft. high, and yielded heavily. Close beside such plants as these were others hardly 3 in. high, pigmies of the same age, stunted by the alkali. A few barley plants were normal, but most of them when headed out were only 3 or 4 in. high. It was evident that the leaching of the plat had been very uneven, owing to the hardness of the soil; and most of the gypsum used in 1892 was used upon the spots where the alkali still remained strongest. . . .

"On the three fourths of an acre where blasting powder had been used . . . the leaching proceeded more slowly than on the first plat, but good progress has been made, and another season a fair crop of wheat and barley can be expected."

A new simple method of determining lime in arable soils, A. DE SAPORTA (*Compt. Rend., 120 (1895), No. 4, pp. 215–217*).—A known weight of the soil to be examined is dropped into a measured quantity, say 200 cc., of hydrochloric acid of known specific gravity (1.1 at 15° C.), and after solution is complete the increase in specific gravity of the acid is determined. It is claimed that in experiments with pure marble the increase in specific gravity was directly proportional to the amount of marble used, and so in examining soils the readings of the hydrometer may be taken as indicating the amount of lime dissolved. Results obtained by this method and by Bernard's calcimeter on 4 samples of soil show close agreement. The merit of extreme simplicity claimed by the author for his method appears to be about the only one it possesses.

Comparison of the action of hydrochloric and oxalic acids in soil extraction, M. E. JAFFA (*California Sta. Rpt. 1893 and 1894, pp. 63–65*).—Two soils, a black adobe and a reddish sandy soil, were each digested in porcelain beakers for 5 days in the usual way in hydrochloric acid of 1.115 sp. gr. and oxalic acid of a corresponding strength.

The hydrochloric acid extract was analyzed in the usual manner.

"In the case of oxalic treatment, the solution was immediately filtered from the insoluble residue; the filtrate evaporated to dryness in a platinum basin, ignited to expel the excess of oxalic acid, and the resulting residue dissolved in hydrochloric acid and treated as usual."

"[The results] show that, on the whole, hydrochloric acid exerts a stronger influence on the soil than does oxalic acid, as in both sets of analyses it is noticed that the insoluble residue is, in the case of the hydrochloric acid digestion, about 2 per cent lower than is that resulting from the action of oxalic acid.

"The amount of potash (0.73 for the adobe and 0.47 for the sandy soil) dissolved is identical in the two treatments, while the quantity of lime extracted by hydrochloric acid is about twice that yielded by the oxalic acid, as is indicated by the figures 1.15 and 0.62 for the adobe soil, and 0.97 and 0.41 for the sandy. As regards magnesia, there is very little difference.

"The percentages of iron and alumina are both lower when oxalic acid is used as the solvent. . . .

"In summing up we might say that, except in the case of lime, the results obtained by the action of oxalic acid on soils could receive the same interpretation as that given to those derived from the hydrochloric acid treatment."

Digestion of soils for analysis, E. W. HILGARD and M. E. JAFFA (*California Sta. Rpt. 1893 and 1894, pp. 61–63*).—In order to ascertain whether the acid commonly used in soil analysis undergoes change of strength in digestion on the steam bath, "50 cc. of hydrochloric acid, of 1.116 sp. gr., obtained by the distillation of the last two thirds of stronger acid under atmospheric pressure, was evaporated on the steam bath to one half its bulk. The same, diluted with 10 per cent of water, was similarly treated. Furthermore, the same experiment was made with 2 porcelain beakers ('soil pots') covered with watch glasses, being kept on the steam bath for 5 days, as usually practiced by us in soil digestion. In the latter two cases, the bulk had been reduced to 36 cc., or by somewhat over one fourth of the original volume."

The results were as follows:

Effect of evaporation on the strength of hydrochloric acid of 1.116 specific gravity.

	Strength of acid (anhydrous hydrochloric acid).		
	Original.	Evaporated to one half its bulk.	Evaporated to 5 cc.
	Per cent.	*Per cent.*	*Per cent.*
Desk acid in open beaker	22.96	21.49	20.96
Desk acid with 10 per cent water	20.67	21.49	
Desk acid in covered porcelain beaker	22.96	21.49	
Desk acid, with 10 per cent water, in covered porcelain beaker	20.67	21.49	

"It will thus be seen that under the ordinary conditions of digestion, as heretofore practiced in this laboratory, the changes arising from evaporation are absolutely insignificant, in comparison with those unavoidably resulting from the variable amount of soluble matters in different soils."

Analyses of water and remarks on water supply, M. E. JAFFA, M. CURTIS, and E. W. HILGARD (*California Sta. Rpt. 1893 and 1894, pp. 157–184*).—Analyses of a large number of samples of stream, lake, spring, well, and artesian water are tabulated and discussed.

The influence of geological-agronomical charting upon soil study, T. WOELFER (*Fühling's landw. Ztg., 44 (1895), No. 2, pp. 42-49*).

Crops and fertilizers, with reference to California soils and practice, E. W. HILGARD (*California Sta. Rpt. 1893 and 1894, pp. 200-213*).—A popular article discussing the draft of different crops on the soil and means of restoring exhausted fertility.

The relations of soils to climate, E. W. HILGARD (*California Sta. Rpt. 1893 and 1894, pp. 100-139*).—A partial and revised reprint of Bulletin 3 of the Weather Bureau of this Department (E. S. R., 4, p. 276).

Fig soils, M. E. JAFFA (*California Sta. Rpt. 1893 and 1894, pp. 235-240*).—A reprint of an article published in Bulletin 102 of the station (E. S. R., 5, p. 286).

On the nitrogen contents of soil humus in the arid and humid regions, E. W. HILGARD and M. E. JAFFA (*California Sta. Rpt. 1893 and 1894, pp. 66-70*).—A reprint of an article in Agl. Sci., 8 (1894), No. 4, pp. 165-171 (E. S. R., 6, p. 197).

Analyses of alkali (*California Sta. Rpt. 1893 and 1894, pp. 149-156*).—Reports of examinations of 22 samples of alkali leachings, crusts, and soils.

Analysis of two Kentucky blue-grass soils, M. E. JAFFA (*California Sta. Rpt. 1893 and 1894, pp. 65, 66*).—The results of analysis of 2 samples of Kentucky soils sent out by the reporter on soils and ash of the Association of Official Agricultural Chemists are tabulated and discussed. Attention is especially called to the high percentages of phosphoric acid, 0.71 and 0.40 per cent. The only soils having amounts approaching these figures are the black waxy soils of Texas, with 0.59 per cent, and basaltic soils of Montana, with 0.59 per cent.

Analyses of rocks, clays, marls, etc. (*California Sta. Rpt. 1893 and 1894, pp. 189-191*).—Brief reports of analyses of marl and clay rock, calcareous rock, cement, peat, borate of lime, and brine; and a list of minerals sent to the station for examination.

Analyses of soils (*California Sta. Rpt. 1893 and 1894, pp. 47-61*).—Mechanical analyses and in most cases chemical analyses of 3 samples of soil from the Sierra Foothills, 7 from the Great Valley, and 4 from the Coast Range are tabulated and discussed, and lists of a large number of samples subjected to partial examination are given.

Analyses of Malmesbury soils, C. F. JURITZ (*Agl. Jour. Cape Colony, 8 (1895), No. 4, pp. 76, 77*).—A continuation of systematic determinations of water, organic and volatile matter, chlorin, lime, potash, and phosphoric acid in the soils of Cape Colony. For previous analyses of soils of the Durban and Koeberg districts see same journal, Jan. 11, 1894, p. 5. Determinations of nitrogen are in progress and soil maps and charts are in course of preparation.

Progress in the culture of sandy soils in the last 15 years, B. MARTINY and A. ORTH (*Jahrb. deut. landw. Ges., 9 (1894), pp. 511-539*).

Reclaiming coast sands, C. B. McNAUGHTON (*Agl. Jour. Cape Colony, 8 (1895), No. 2, pp. 57-65, figs. 14; No. 3, pp. 57-59, figs. 6; No. 4, pp. 91-96, figs. 6*).—An account of the methods used on the sand dunes of Gascony, France.

FERTILIZERS.

Green manuring with cowpeas and other crops (*New Jersey Stas. Rpt. 1893, pp. 146-150*).—This article gives the plan of an experiment for the improvement of light lands by the use of crimson clover and cowpeas, and a statement regarding the method of cultivating cowpeas on a large scale in New Jersey. Cowpeas, following crimson clover, yielded at the rate of 14,400 lbs. of green material per acre. The vines contained 2,278.1 lbs. of organic dry matter, 70.6 lbs. of nitrogen, 17.3 lbs. of phosphoric acid, and 50.4 lbs. of potash. The roots on 1 acre weighed only 1,080 lbs. and contained 295.2 lbs. of

organic dry matter, 4.2 lbs. of nitrogen, 1.5 lbs. of phosphoric acid, and 4.4 lbs. of potash per acre. The roots and vines grown on an acre contained a total of 34.8 lbs. of nitrogen, 18.8 lbs. of phosphoric acid, and 54.8 lbs. of potash. The nitrogen in the vines is equivalent to that contained in 437½ lbs. of nitrate of soda, and is valued at about $11.

Report of pot experiments with phosphates, W. H. BISHOP (*Delaware Sta. Rpt. 1893, pp. 193–202, figs. 2*).

Synopsis.—In comparative tests of soft Florida phosphate, crude iron and alumina phosphate, concentrated iron and alumina phosphate, and acid phosphate, combined with nitrate of soda and muriate of potash on soja beans grown in 3 series of pots containing (1) 16 lbs. of clayey soil, (2) 20 lbs. of sandy soil, and (3) 20 lbs. of ground quartz, the first two phosphates gave no increase in crop; the last two increased the yields equally.

The soft Florida phosphate used contained 28.81 per cent of insoluble phosphoric acid, the "raw ground rock" (iron and alumina phosphate) 36 to 38 per cent of insoluble phosphoric acid, the concentrated phosphate (of iron and alumina) 38 to 40 per cent of available phosphoric acid and 49 to 50 per cent of total phosphoric acid, and the acid phosphate 15 per cent of phosphoric acid. These were each applied, at rates furnishing the same amounts of phosphoric acid, in combination with muriate of potash and nitrate of soda, in 3 series of galvanized iron pots containing different kinds of soil, viz, a clayey soil from the station grounds (16 lbs. per pot), a sandy soil from near Dover, Delaware (20 lbs. per pot), and ground quartz (20 lbs. per pot). In case of the sandy and clayey soils an additional pound of sand was added to the surface of each pot. For comparison some of the pots received gypsum alone and combined with muriate of potash and nitrate of soda, and others received no fertilizer. The soils were carefully mixed and sifted and the fertilizers thoroughly incorporated with them. Soja bean was the plant used. The pots were watered when it seemed necessary, the amount of water applied at each watering being 70 per cent of that which the soil would hold at saturation. The tabulated data show for each series the kind and amounts of different fertilizers applied, the water added, and the yields of stems (without leaves) and beans on each duplicate plat and the average yields.

The conclusions reached were as follows:

"(1) Soft Florida phosphate and 'raw ground rock' (iron and alumina phosphate) gave no increase in the crop.

"(2) 'Concentrated phosphate' gave as good results as acid phosphate.

"(3) When a full supply of water is added to soil that is already in a fair state of fertility the differences in the crop produced by the addition of fertilizers, even in large quantities, are not very great."

Methods of preparing phosphates of alkalies from phosphates of lime and iron, E. A. SCHEIDER (*Chem. Ztg., 19 (1895), No. 10, Repert., p. 34; Ztschr. angew. Chem., 1895, No. 4, p. 109*).—The following method is applicable to natural phosphates of lime, Thomas slag, and phosphates rich in iron oxid. The phosphate is dissolved in sulphuric acid,

which is used in large excess when the iron content is low. In this case the excess of sulphuric acid is saturated with iron hydrate which is obtained as a by-product in a subsequent stage of the process. To the solution of phosphate of iron in sulphate of iron thus obtained water is added, which precipitates a considerable portion of the phosphate of iron. The solution remaining is used for the decomposition of another portion of phosphate, additional sulphuric acid being added to it. The phosphate of iron obtained is decomposed with potash solution, or if an apparatus for dialysis on a large scale is provided an ammoniacal solution of the phosphate of iron may be dialyzed to the point where the phosphate of ammonia disappears and the undecomposed residue of phosphate of iron is then treated with potash solution.

The solubility of basic slag, C. H. RISDALE (*Chem. News, 71* (*1895*), *No. 1838, pp. 82, 83*).—In this paper, read before the Cleveland Institute of Engineers January 14, 1895, the author criticises Wagner's conclusions regarding the relation between citrate solubility, silica content, and fertilizing value of slags (E. S. R., 6, p. 625). He especially dissents from the expression of results in terms of percentage solubility.

Investigation showed that tetrabasic phosphate of lime, whether natural or artificial, was completely dissolved in Wagner's citrate solution, and "that increased quantities of poorer slags, containing the same quantity of soluble phosphoric acid as richer varieties, and which should, when treated with fixed quantities of solvent (as would under actual agricultural conditions be the case), yield an equal amount [of phosphoric acid], do not, but yield much less." It was also shown that "the alleged close relation between the silica content and the percentage solubility had almost as many exceptions to the rule as examples of it, and that there was a point beyond which the higher the silica the less the solubility."

A study of the conditions influencing solubility lead to the following conclusions:

"The percentage solubility depends on—

"(1) The actual content of phosphoric acid, varying inversely to it.

"(2) The neutrality or freedom from excess of lime (and possibly certain other bases).

"(3) Silica does not *per se* increase this, but only (*a*) when it combines with and thus neutralizes excess of lime, and possibly certain other bases; (*b*) when as a condition of the presence of a large quantity of silicate of lime (which silicate appears not to interfere with the solubility in the quantities in which it is generally present) there is only a low total percentage of phosphoric acid present.

"(4) Silica decreases this when present in quantities greater than required in 3, or sufficiently large to bring about the formation of silicates of iron or manganese.

"(5) Excess of oxids of iron and manganese have a very small effect, almost negligible when compared with that of lime, the actual solubility being the resultant of the inert action of such of these conditions as are present.

"The absolute solubility, or actual amount dissolved, depends on the actual content of phosphoric acid, varying directly with it, and in other respects following 2, 3, 4, and 5."

Fertilizer inspection and analyses in New Jersey (*New Jersey Stas. Rpt. 1893, pp. 17–103*).—This includes statistics of the fertilizer trade in 1893 and 10 preceding years; data as to the market prices of fertilizers; remarks on the economic purchase and rational use of complete and incomplete fertilizers, and on formulas, composition, and cost of home mixtures; and tabulated analyses of 405 samples of fertilizing materials, including nitrate of soda, sulphate of ammonia, dried blood, dry ground fish, cotton-seed meal, wool waste, cotton hulls, ground bone and tankage, bone, acid phosphate, dissolved boneblack, bone ash, South Carolina rock, and other mineral phosphates, Odorless Phosphate (slag), muriate of potash, kainit, sulphate of potash, sulphate of potash and magnesia, ashes, factory-mixed fertilizers, and home mixtures.

The price of complete fertilizers declined from 1885 to 1893, but this decline "was not accompanied by a corresponding decrease in the absolute amounts of plant food delivered to consumers." The use of fertilizers in the State is increasing, their cost amounting to $1,641,615 in 1893 as against $1,509,921 the previous year.

"Farmers can make mixtures which are equal to the best manufactured brands and superior to the average—first, in mechanical condition; second, in concentration; third, in quality, and fourth, in point of cost.

"Many farmers' clubs and granges are now buying their [fertilizing materials in bulk and doing their own mixing] and several transactions by such organizations this year, which involved the purchase of 700 tons of materials, were carefully studied by the station in order to show the actual gains that were made. The 700 tons cost $20,790, or on an average at the rate of 14.9 cts. per pound for nitrogen, 5.7 cts. per pound for available phosphoric acid, and 4 cts. per pound for potash. The average cost per pound of these fertilizer elements, bought in mixed goods from dealers, is this year 24.8 cts. for nitrogen, 9.4 cts. for available phosphoric acid, and 6.7 cts. for potash. The total cost of the amounts of constituents contained in the 700 tons would, on this basis, have been $34,489, or a difference in favor of the former method of $13,699, on a transaction which represents less than one thirtieth of the total annual consumption in the State. This study also showed that if the average manufactured fertilizer had contained as much plant food as was contained in the mixtures made from the 700 tons of materials purchased, the total amount used in 1892 would have been contained in 23,172 tons, instead of 33,821 tons, or a difference of 10,649 tons. A comparison of the selling price and valuation of the mixed goods examined this year shows further that the cost to the farmer for mixing, bagging, and selling averaged $9.70 per ton, or a total for the 10,649 tons of $93,295. That is, the labor connected with the handling and selling of 10,000 tons of absolutely worthless materials amounted to nearly $100,000.

"In buying manufacturers' mixtures distinct advantages in quality and cost are secured when bought direct from the manufacturers instead of from local agents."

Fertilizers, S. M. TRACY (*Mississippi Sta. Rpt. 1893, pp. 40–43*).—A summary of Bulletin 29 of the station (E. S. R., 6, p. 395).

The use of human excrement as a fertilizer, J. H. VOGEL (*Deut. landw. Presse, 22 (1895), No. 8, pp. 66, 67; No. 10, pp. 83, 84; No. 11, p. 92*).

The cause of the relatively incomplete utilization of the nitrogen of stable manure, P. WAGNER (*Deut. landw. Presse, 22 (1895), No. 11, pp. 91, 92; No. 12, pp. 98, 99, figs. 15*).

The loss in the fertilizing value of stable manure when exposed, G. CATANI (*Staz. Sper. Agr. Ital., 28 (1895), No. 1, pp. 60–67*).

Management of farmyard manure (*Agl. Jour. Cape Colony, 8 (1895), No. 2, p. 40*).—General comment, including a brief description of methods pursued by the Longerenong Agricultural College, Australia.

Experiments in conserving stable manure by covering it with earth, A. GRILLI (*Staz. Sper. Agr. Ital., 28 (1895), No. 1, pp. 68–74*).

Practical experience concerning the effect of stable manure in the light of recent investigations, P. WAGNER (*Deut. landw. Presse, 22 (1895), No. 14, p. 123*).

The nitrogenous fertilizers of commerce, C. DUSSERRE (*Chron. Agr., 8 (1895), No. 5, pp. 102–105*).—Brief general statements.

A study of the agricultural value of the phosphate of alumina of Grand-Connétable, A. ANDOUARD (*Compt. Rend., 120 (1895), No. 6, pp. 337–339*).—This phosphate was compared with other mineral phosphates, including Algerian, Somme, South Carolina, and Florida phosphates in pot experiments on balsam, flax, white mustard, and buckwheat, with results indicating that it may be profitably used in untreated condition. More complete field experiments are stated to be in progress.

On the agricultural value of the phosphates of alumina—remarks on the previous note, A. GAUTIER (*Compt. Rend., 120 (1895), No. 7, pp. 356–358*).—Recounts 3 years' field experiments on a large scale with Redonda and Connétable (Guana) phosphates, which confirm Andouard's conclusions as to the high assimilability of such phosphates, but it is maintained that this high assimilability is confined to those phosphates indirectly resulting from fermentation of nitrogenous matter, and generally in an amorphous or indistinctly or partially crystallized condition.

Preparation of a fertilizing material containing citrate-soluble phosphoric acid, O. PEIPER (*Chem. Ztg., 19 (1895), No. 11, p. 221*).—A patented process in which fine ground iron or aluminium phosphate is stirred into a hot solution of lime in soda or potash.

Fertilizers and gypsum (*California Sta. Rpt. 1893 and 1894, pp. 192–200*).—Analyses of 3 samples of fertilizers and 37 samples of gypsum or gypseous earths, with accounts of gypsum mines located near Mendota, Fresno County, and in San Benito County, California.

Field experiments on white mustard with nitrogen in green manures and barnyard manure, J. KÜHN (*Ztschr. landw. Cent. Ver. Sachsen, 1895, No. 1, pp. 4–12*).

Manure in its relations to plant evaporation, C. D. REED (*Amer. Agr., (middle ed.), 1895, Feb. 23, p. 194*).

Analyses of commercial fertilizers, T. J. EDGE and W. FREAR (*Pennsylvania State Bd. Agr. Bul., Jan. 1, 1895, pp. 24*).—Text of the act regulating the manufacture and sale of commercial fertilizers in Pennsylvania; schedule of trade value of fertilizing ingredients, with notes on valuation; and tabulated analyses and valuations of 342 samples of fertilizing materials, including ground bone, acid phosphate, and mixed fertilizers.

FIELD CROPS.

Experiments with corn, S. M. TRACY (*Mississippi Sta. Rpt. 1893, pp. 18–23*).—These consisted of variety tests and fertilizer experiments. The largest yields in 1889 were made by Mosby Prolific, St. Charles Parish, White Dent, Improved Leaming, Welborn Conscience, and Piasa King; in 1890 by Mosby Prolific, Cock Prolific, Minter Prolific, Bailey, Mammoth Surprise, and Evans. In 1889, 1890, and 1892 the white varieties yielded more than the yellow varieties.

"As a rule the yellow varieties make larger ears, but we have found very few which average more than 1 ear to the stalk. Of those varieties noted as being the best 6, the white varieties averaged 127 ears to 100 stalks, while the yellow varieties bore only 105 ears to 100 stalks. . . . It is probably true that the yellow varieties stand up better in the field and are less liable to rot when left in the field until late in the season."

The results of fertilizer tests varied according to the soil on which the crop was grown. In 1889, on a very heavy dry clay soil, 500 lbs. of fresh cotton seed gave the largest yield. In 1890 and in 1891 the most profitable fertilizer was a compost of stable manure, cotton seed, acid phosphate, and kainit. In 1892, on a heavy red clay soil from which the surface soil had been badly washed and which had given a light crop of lespedeza the preceding year, 240 lbs. of cotton-hull ashes gave the largest yield, an increase of 123 per cent over the yield of the unfertilized plats. In 1893, on a heavy soil which had grown a crop of cowpeas in the preceding year, 500 lbs. of kainit to the acre more than doubled the yield of the unfertilized plat. Results of fertilizer tests at Holly Springs are also stated.

"From the work which has been done both at Holly Springs and at the home station, there seems to be no great difference between the fertilizers required for corn and those which are most needed for cotton. The first essential for both is evidently an abundant supply of humus, which can be provided most economically by the plowing under of green leguminous crops, but which may be supplied in stable manure, cotton seed, or [cotton-seed] meal With a soil rich in humus and in lime, potash should be used liberally, while but little phosphoric acid and no nitrogen need be given. Where lime is deficient both potash and phosphoric acid should be used, and if deficient in humus, nitrogen should also be applied in the form of [cotton-seed] meal for sandy soils and [cotton] seed for heavy clay uplands."

Experiments with cotton, S. M. TRACY (*Mississippi Sta. Rpt. 1893, pp. 6–17*).

Synopsis.—The results of 5 years' work in fertilizer tests in 3 localities and of variety tests are summarized. Fertilizer tests indicate that the soil of the station farm is especially benefited by manures or fertilizers rich in organic matter and potash. At the Holly Springs Substation results were not decisive. At the Lake Substation phosphoric acid proved superior to potash. The value of the crop for the 6 varieties affording the greatest value per acre (in lint and seed) in each of the 5 years of the experiment are given and the results for 1893 are tabulated in full.

Fertilizer experiments (pp. 6–13).—At the station in 1889 200 lbs. of kainit per acre proved the most effective and economical fertilizer. In 1890, on a similar soil, the Furman compost (containing 750 lbs. of stable manure, 750 lbs. of cotton seed, 333 lbs. of acid phosphate, and 167 lbs. of kainit per ton) proved most economical, though sulphate of potash afforded nearly the same yield.

In 1891, on an exhausted, dry, yellow clay hill the best results followed the use of 1,000 lbs. of cotton seed per acre; on a heavy red clay soil 15 tons per acre of stable manure produced the largest yield, while kainit gave the cheapest increase in crop; on an exhausted yellow loam the substitution of kainit for the acid phosphate in the Furman compost largely increased the yield and cheapened the cost of production both in 1891 and 1892. Again in 1893 a compost rich in potash gave a larger yield than one relatively poor in this ingredient and rich in phosphoric acid; 500 lbs. of kainit alone increased the yield by 222 lbs. of seed cotton per acre, while 250 lbs. of acid phosphate alone produced no notable effect.

"All of the soil used for this work at the home station has been rich in lime and very poor in humus. From the work which has been done here during the last 5 years, the results have been quite uniform, and indicate very plainly that for such soils the first work in restoration must be the providing of a liberal supply of humus, which may come from either stable manure, cotton seed, or the plowing under of green leguminous crops, and that any additional fertilizers used should be rich in potash, though they need contain but little phosphoric acid."

At Holly Springs results for the different years do not accord.

"So far as can be seen from the work done, the upland clay soils of that region will be fertilized most economically by the use of either [cotton seed] meal or compost to furnish vegetable matter and nitrogen, and to these should be added both phosphoric acid and potash, more of the latter than the former being needed. For the sandy valley lands cotton-seed meal seems the best foundation for the fertilizer, and to that should be added more phosphoric acid than potash, though both are needed."

At Lake, in the pine woods region, the average yields of seed cotton per acre on a sandy clay loam containing but little lime were as follows:

Average yields per acre of seed cotton for 3 years.

Fertilizer.	Yield of seed cotton.
	Pounds.
Nothing	614
35 bu. cotton seed, or 200 lbs. cotton-seed meal 200 lbs. kainit	846
35 bu. cotton seed, or 200 lbs. cotton-seed meal 200 lbs. acid phosphate	1,253
35 bu. cotton seed, or 200 lbs. cotton-seed meal 200 lbs. acid phosphate 200 lbs. kainit	1,105
50 bu. cotton seed 400 lbs. acid phosphate 200 lbs. cotton-hull ashes	1,169
100 bu. cotton seed 200 lbs. acid phosphate 200 lbs. cotton-hull ashes (2 years)	1,249

Variety tests (pp. 13–17).—The most profitable varieties were as follows:

Varieties of cotton producing the greatest value per acre in lint and seed.

1889.

Ferrell Prolific.
Truitt Premium.
Jones Long Staple Prolific.
Excelsior.
Dickson Improved.
Truitt Improved Prolific

1890.

King.
Southern Hope.
Extra Early Carolina.
Truitt Premium.
Tennessee Gold Dust.
Texas Wood.

1891.

Eureka.
Texas Storm Proof.
Allen.
Drake Cluster.
Bailey.
Willis.

1892.

Warren.
Jones Long Staple Prolific.
Drake Cluster.
King.
Smith Standard.
Truitt Premium.

1893.

Cook.
Poor Man's Friend.
Truitt Premium.
Dickson Improved.
Warren.
Bates Big Boll.

"Of the so-called varieties we have a very large number, but of what may be called 'types' there are but 4 which are so distinct as to be generally recognized. These are the Cluster and Long-Limbed, the Long Staple and the Short Staple, and in each of those we have many inconstant 'varieties' which change their character with every change of soil.

"In comparing varieties of the 'long-limbed' and the 'cluster' types we have found no constant differences in the yields, though the cluster varieties have always matured later than have some of the long-limbed sorts; while a long-limbed variety which produces unusually large bolls always matures later than do most of the cluster varieties. . . .

"With nearly 100 so-called varieties which have been tested, the average yield of the short-staple sorts has been nearly double that of the long staples."

Neither Japanese, Peruvian, nor Egyptian varieties proved valuable on the station farm.

Cowpeas, H. N. STARNES (*Georgia Sta. Bul. 26, pp. 163–185, figs. 85*).—Experiments conducted on cowpeas in 1894 consisted of fertilizer tests, variety tests, and a comparison of badly discolored, slightly discolored, and perfect seed. The main purpose of the fertilizer experiment was to determine the relative values of Florida soft phosphate and superphosphate, alone and in different combinations. The following is the author's summary:

"(1) It is money thrown away to apply any form of nitrogenous fertilizer to the cowpea. . . .

"(2) The use of potash salts in large quantities is unprofitable, and even in small quantities will not pay in the oak and hickory region of the South. On other than oak and hickory lands small doses may prove profitable in conjunction with acid phosphate, and the longer the land has been in cultivation the greater becomes this probability, even in the oak and hickory belt.

"(3) Heavy applications of any form or combination of fertilizers are unprofitable.

"(4) The moderate use of phosphates [alone] appears still to return the best results from an economical standpoint.

"(5) As between superphosphate (acid phosphate) and Florida soft phosphate (unacidulated ground rock) results indicate decided preference for the former, so far as the growth of vines is concerned.

"(6) There is less difference observable between the two in the formation of peas, though superphosphate still appears to be preferable.

"(7) The finely pulverized condition of soft phosphate is a great objection to its use, rendering it extremely difficult to handle without loss.

"(8) There is not a sufficient difference in price between the two forms of phosphate to render soft phosphate at present an active competitor to acid phosphate, unless the ascertained results were more emphatic in its favor. . . .

"(9) The quantity of acid phosphate which may be safely depended upon differs, of course, with the character of the land. The better the soil (in its mechanical composition as well as in its chemical contents) the greater the amount that may be profitably used. A range of from 200 to 400 lbs. per acre will probably cover all contingencies."

The 46 varieties grown at the station in 1894 are described and figured. Cowpeas are classified according to the form of the pea, habit of growth, time of maturity, color of pod, color of peas, size of pod, and size of peas. Two forms of cowpea are described, the Crowder and Kidney types. In habit of growth the varieties are classified as follows:

"*Trailing:* Conch, Red Eye, Williams Hybrid.

"*Recumbent:* Calico, Congo, Large Lady, Lilac Red Pod, New Era, Pony, Red Crowder, Red Ripper, Saddleback, Small Lady, Smith No. 7, Smith No. 9, Smith No. 14, Speckled Crowder, Sugar Crowder, Vacuum, White, White Brown Hull, White Crowder, White Giant.

"*Semi-Recumbent:* Black, Black Eye, Blue Hull, Chocolate, Constitution, Everlasting, Forage or Shinny, Granite, Gourd, Mathews, Mush, Purple Hull Crowder, Redding, Red Yellow Hull, Rice, Shrimp, Smith No. 15, Taylor Prolific.

"*Erect:* Clay, Coffee, Quadroon, Red, Unknown, Whippoorwill, Wonderful."

In time of maturity the classification is as follows:

"*Very Early:* Chocolate, Congo, New Era, Vacuum, White Giant.

"*Early:* Granite, Red Crowder, Red Eye, Red Yellow Hull, Saddleback, Smith No. 9, Whippoorwill.

"*Medium:* Coffee, Large Lady, Lilac Red Pod, Mush, Pony, Small Lady, Smith No. 7, Smith No. 15, White, White Brown Hull.

"*Late:* Black Eye, Everlasting, White Crowder, Williams Hybrid.

"*Very Late:* Black, Blue Hull, Calico, Clay, Conch, Forage or Shinny, Gourd, Mathews, Purple Hull Crowder, Quadroon, Red, Redding, Red Ripper, Rice, Shrimp, Smith No. 14, Speckled Crowder, Sugar Crowder, Taylor Prolific, Unknown, Wonderful."

The yields of vines and of peas for each variety are tabulated. The following are the author's conclusions:

"(1) The earliest cowpea, and hence the variety best adapted to high latitudes, is the New Era; this matures in a little more than 60 days from time of planting. Other very early varieties are Congo, White Giant, Chocolate, and Vacuum.

"(2) The heaviest yielder of vines is Red Ripper, followed closely by Forage or Shinny, Black, and Unknown.

"(3) The heaviest producers of peas are Unknown, Calico, Clay, and White Brown Hull.

"(4) The yield of peas, as a rule, though not invariably, parallels the yield of vines.

"(5) For hay, the erect varieties are preferable to those of a recumbent habit, since the mower cuts them all. The best of the erect varieties are the Unknown, Clay, and Whippoorwill.

"(6) Where a dense mass of vines is wanted to remain all winter on the ground, Calico, Gourd, Black, and Constitution are preferable.

"(7) The best table peas are Sugar Crowder, White Crowder, Mush, Large Lady, Small Lady, and Rice.

"(8) The best stock pea for field grazing of either cattle or hogs is the Black. It will remain in ground all winter without injury. Everlasting, Red, and Red Ripper are also good.

"(9) For an 'all purpose' pea the Unknown leads the list. Clay, however, closely contests first place. Unknown and Wonderful are identical."

Neither the germinating power nor the subsequent growth was lessened by discoloration of the peas used as seed.

Experiments with cowpeas and crimson clover, A. T. NEALE (*Delaware Sta. Rpt. 1893, pp. 7–13*).—Silage made of cowpea vines was relished by cows and largely increased the flow of milk. In a fertilizer test 160 lbs. of muriate of potash per acre doubled the yield of cowpea vines; nitrate of soda largely increased the yield, but acid phosphate exercised no marked effect. The varieties Unknown and

Conch failed to ripen seed, but the Black cowpea yielded at the rate of 25 bu. of seed per acre when fertilized with muriate of potash. Heavy seeding of cowpeas, by using all the tubes of a grain drill, is recommended.

Italian rye grass sown with crimson clover produced sufficient seed after the first cutting to reseed the land.

Crimson clover straw moistened with water which had been sweetened with low-grade molasses was successfully used as a substitute for hay in feeding cows.

The yield of wheat was largely increased by plowing under a crop of crimson clover in May and a crop of cowpeas in September.

Experiments with oats, G. LIEBSCHER (*Jahrb. deut. landw. Ges., 9 (1894), pp. 453–510*).—These experiments with varieties extended over 5 years and were conducted in numerous localities in Germany. On averaging the yields for 5 years of a number of varieties grown on different classes of soils, it was found that whenever a variety was productive as compared with other varieties on one class of soil it was relatively productive on all other soils. The author states that there is no foundation for the claim that one variety ranks high in yield on one class of soils but low on another.

However, when a variety was originated and the seed grown on one kind of soil it proved more productive (relative to other varieties) on similar soil than on that of a different character. On light soil seed grown on light soil was more productive than seed grown on heavy soil. Seed grown on heavy soil showed a preference for heavy soil.

Varieties originating in a region with a continental climate were most successfully grown in a similar climate; those originating in a marine climate were most productive under similar climatic conditions.

As in previous years varieties did not differ in their percentages of nitrogen and phosphoric acid; these percentages, however, were influenced by the character of the soil on which the crop was grown, by the fertilizers used, and by the weather.

Peanuts, culture and uses, R. B. HANDY (*U. S. Dept. Agr., Farmers' Bul. 25, pp. 24*).—The following subjects are treated: Description and history, composition, with analyses of food and fertilizing constituents in different parts of the plant, varieties, climate and soil adapted to the peanut, manuring, preparation of the land, selection of seed, planting, tillage, harvesting, and uses. A crop of 60 bu. (1,380 lbs.) of peanuts, together with 2,000 lbs. of hay, total 3,380 lbs., is estimated to contain 84.71 lbs. of nitrogen, 14.80 lbs. of phosphoric acid, 32.30 lbs. of potash, and 46.30 lbs. of lime. If the soil for peanuts does not contain lime this should be applied as a fertilizer, together with phosphoric acid and potash. A rotation suggested for peanuts is as follows: Peanuts, followed in the fall by winter rye or oats, and the next summer the land sown to crimson clover, to be followed the next year by peanuts again, so that every other year peanuts will be the crop. Care

in the selection of seed is urged. Analyses show that peanut hay and peanut cake have a high feeding value.

Originating varieties of potatoes, G. LIEBSCHER (*Jahrb. deut. landw. Ges.*, *9* (*1894*), *pp. 303–318*).—The theory and history of plant breeding are discussed at some length. Modern potato breeders select as parents 2 varieties which in most qualities bear close resemblance to each other, avoiding the use of opposites. Their aim is to secure as much similarity as possible in most of the qualities of the parents, attempting to fix one characteristic at a time.

This is somewhat in contrast with earlier practice, in which varieties differing widely were crossed. As an instance of the advantages of the modern method, which gives a smaller amount of variation in the seedlings produced, one potato breeder stated that under the earlier system he sometimes grew annually several thousand seedlings, only 1 per cent of which was worthy of a second year's trial, while by crossing varieties similar in most qualities as many were secured by growing only 300 to 500 seedlings, of which 50 to 70 per cent usually proved worthy of further trial.

Breeders no longer expect to get certain qualities from the female parent and certain others from the male.

The interrelation of different qualities is not well known, but it has been noted that a variety having few thick stalks affords only a small number of tubers, which are large; one having numerous slender stalks bears numerous tubers, which naturally remain small. Violet-colored stalks indicate colored tubers; white flowers generally, but not always, accompany white tubers. Early ripening and resistance to disease are not generally found together. A large production of true seed is believed to go hand in hand with a small production of tubers.

Whether or not the time of ripening of a variety can be changed by selection and by varying the time of planting is a mooted question among potato breeders.

In pollenizing varieties artificially the stamens should be removed from the female parent with fine pinchers just as the bloom opens, and the flower inclosed in a paper or gauze bag. The proper stage for applying the pollen is indicated by the moist appearance of the stigma. The pollen from the desired variety should be dusted on the stigma on 2 or 3 successive days, so as to make sure of fertilization. The bag is removed as soon as the stigma dries and the bloom withers.

The seeds are washed out from the ripe seed balls, dried, and at the proper season sown shallow under glass. The seedlings are first transplanted in a hotbed, and later the strongest plants are placed in a rich bed out of doors. The distance between the seedlings varies from 12 by 12 in. to 26 by 26 in. The old rule that in the first year the seedlings should produce tubers of the size of a hazelnut, in the second year of walnut size, and normal tubers not before the third year is no longer applicable. In one instance a seedling produced the first year tubers weighing about 200 gm. (over 7 oz.).

The tubers produced by each plant are kept separate. Those of the best plants are used for propagation the following year, the distance allowed by some breeders in the second year being only 25.6 by 12.8 in., by others 40 by 40 in. Close planting is sometimes advocated as affording the conditions under which the plant is in future to be grown on a large scale. Wide planting permits of easier observation of each plant, is less subject to errors arising from an irregular stand, and is the method favored by the author. The best stocks are planted in the third year on areas of 20, 50, or 100 square meters, are given the usual field culture, and compared in yield and qualities with well-known varieties. It is usually 5 years before there is obtained a type so fixed and valuable as to serve for future crossing and to deserve a name.

Fertilizer experiments on Irish potatoes (*New Jersey Stas. Rpt. 1893, pp. 120–124*).—Experiments on twentieth-acre plats were conducted in Gloucester County on a sandy, well-drained loam of medium fertility, and in Somerset County on a gravelly clay loam with good drainage. Three hundred and twenty pounds of boneblack, 160 lbs. of muriate of potash, 240 lbs. of sulphate of potash, and 200 lbs. of nitrate of soda were used in various combinations. Stable manure was used alone at the rate of 20 tons per acre, and at the rate of 10 tons per acre in combination with half the above amounts of commercial fertilizers. On 2 plats the quantity of commercial fertilizers was 50 per cent greater than that indicated above. The following table gives the cost of fertilizers per acre, the value at 75 cts. per bushel of salable crop after deducting cost of fertilizers, and the value of the increase after deducting cost of fertilizers:

Financial results per acre from the use of stable manure and chemical fertilizers on Irish potatoes.

	Cost of fertilizer.	Gloucester County.		Somerset County.	
		Net value of crop.	Net value of increased crop.	Net value of crop.	Net value of increased crop.
Unfertilized	....	$31.50	....	$54.38	....
Stable manure alone	$10.00	71.01	$39.51	38.75	—$15.63
Stable manure and chemical manure	39.26	84.65	53.15	46.14	— 8.24
Complete chemical manures alone	15.10	71.24	39.74	82.12	27.74

In the first experiment both chemical fertilizers and stable manure were used with profit; in the second experiment only chemical fertilizers returned a profit.

Ramie, W. C. Stubbs (*Louisiana Stas. Bul. 32, pp. 1127–1146*).—The possibilities of ramie culture, the character of the ramie plant and fiber, the draft made on the soil fertility by ramie, and machines for preparing ramie fiber are treated at length. The data relative to the composition and fertilizer requirements are quoted from Bulletin 94 of the California Station (E. S. R., 3, p. 371).

The ramie plant is perennial and yields from 8 to 15 tons of green unstripped stalks per acre. Ramie may be decorticated either when the stalks are green or dry. In the humid climate of Louisiana the fiber should be prepared from green stalks. Some machines are adapted to working ramie dry, others to working it green, and a few claim to work the stalks either green or dry.

In the fall and winter of 1894 a committee tested at the station 3 decorticating machines. One of the machines decorticated 1,000 lbs. of freshly cut unstripped stalks in 1 hour 5½ minutes, and the fiber produced when dried weighed 56 lbs. In another test this machine decorticated 500 lbs. of green unstripped stalks in 24 minutes, yielding 30½ lbs. of dry fiber.

Another machine decorticated 112 lbs. of dried ramie stalks without leaves in 2 hours 11 minutes, during which time the machine was in actual operation only 52¾ minutes; the product was 30 lbs. of fiber. In another trial 380 lbs. of green ramie stalks, stripped (equal to 655 lbs. of unstripped stalks), were decorticated with saturation in 50 minutes; the product was 25¼ lbs. of dry fiber. In other tests, green unstripped stalks were decorticated at the rate of 825.9 and 1,200 lbs. per hour.

A smaller machine decorticated dry ramie stalks at the rate of 322 lbs., and green unstripped stalks at the rate of 960 lbs. per hour.

One of the machines delivered the fiber in a somewhat tangled condition and left a piece of adherent wood at the end of each fiber. Another machine required too much power. The outlook for obtaining a successful ramie machine is regarded as promising.

Fertilizer experiments with salt grass (*New Jersey Stas. Rpt. 1893, p. 137*).—Nitrate of soda alone and in combination with superphosphates and muriate of potash failed to increase the yield of the salt grass (*Juncus geraldi*).

Experiments with wheat, S. M. TRACY (*Mississippi Sta. Rpt. 1893, pp. 23–25*).—Several varieties of English and French wheat were grown at the station. The English varieties failed; the French varieties, White Naples and Rieti, proved valuable. The average yield for 3 years of wheat grown on prairie or creek bottom soil was 21.3 bu. per acre. A crop of wheat and of corn was grown on the same field within 12 months, one variety of wheat yielding 24.1 bu. per acre, and the corn yielding 26 bu. per acre.

The best fertilizer for wheat on a gray loam, somewhat sandy, was a mixture of 400 lbs. of acid phosphate, 250 lbs. of kainit, and 400 lbs. of castor pomace per acre. This mixture increased the yield 131 per cent.

Wheat, barley, oats, rye, and spelt, C. H. SHINN (*California Sta. Rpt. 1893 and 1894, pp. 393–397*).—Tabulated data give the time of ripening and of cutting, length of straw and ear, yield of grain and of straw, and brief notes on the character of growth and grain for 64 varieties

of wheat, 17 of barley, 12 of oats, 5 of rye, and 6 of spelt. The largest yield of wheat was made by California Spring wheat, followed by Clawson, Imperial Circassian, and Jonquil. The largest yields of rye were made by Department of Agriculture No 2 and Department of Agriculture No. 6. The most productive variety of oats was White Wonder. Excelsior Winter and St. John's Day rye gave the largest yields of grain, Spanish Double-Bearing and St. John's Day the largest yields of straw. The most productive variety of spelt was White Silesian.

A rotation for dairy farms (*New Jersey Stas. Rpt. 1893, pp. 151, 152*).—A rotation intended to furnish a continuous supply of green fodder was begun in 1893, and the plan was as follows: First year, field corn, seeded to crimson clover in July or August; second year, crimson clover, followed by fodder corn and the land seeded to rye after the corn; third year, rye fodder, followed by oats and peas, seeded to red clover and timothy; fourth year, hay.

Species of agave and their industrial utility, R. ROLAND-GOSSELIN (*Bul. Jour. Soc. Cent. Agr. Alpes-Maritimes, 35 (1895), No. 1, pp. 17–21*).

German and American red clover, O. BURCHARD (*Mitt. deut. landw. Ges., 1895, No. 2, pp. 15–17*).

Crimson clover (*New Jersey Stas. Rpt. 1893, pp. 153–155*).—Brief statements concerning the crops grown on 3 farms in different sections of the State.

Corn, R. L. BENNETT and G. B. IRBY (*Arkansas Sta. Rpt. 1894, pp. 61–67*).—A reprint from Bulletin 27 of the station (E. S. R., 6, p. 215).

The chemistry of the cotton plant (*Mississippi Sta. Rpt. 1893, pp. 50–52*).—A brief report of work already published in Technical Bulletin 1 of the station (E. S. R., 4, p. 719).

Cotton, potatoes, and vegetables, C. H. SHINN (*California Sta. Rpt. 1893 and 1894, pp. 392, 393*).—Several varieties of cotton and 16 of potatoes were grown. Neither potatoes, carrots, nor turnips proved successful. Other plants grown were watermelons, cucumbers, gourds, snap beans, garden peas, and tomatoes. Tomato vines, protected late in autumn "with lath frames," were kept alive and growing through frosts as low as 26° F., but a temperature of 19° killed the vines.

Cotton, R. L. BENNETT and G. B. IRBY (*Arkansas Sta. Rpt. 1894, pp. 70–72*).—A reprint from Bulletin 27 of the station (E. S. R., 6, p. 215).

Preparation of soil for cotton, C. L. NEWMAN (*Arkansas Sta. Rpt. 1894, pp. 100–103*).—A reprint from Bulletin 28 of the station (E. S. R., 6, p. 402).

Cowpea hay, R. L. BENNETT and G. B. IRBY (*Arkansas Sta. Rpt. 1894, pp. 73–79*).—A reprint from Bulletin 27 of the station (E. S. R., 6, p. 215).

Flax, S. M. TRACY (*Mississippi Sta. Rpt. 1893, pp. 27, 28*).—Several varieties of flax were grown at the station, but the yield was too small for the crop to be profitable.

Forage plants, R. L. BENNETT and G. B. IRBY (*Arkansas Sta. Rpt. 1894, pp. 79–83*).—A reprint from Bulletin 27 of the station (E. S. R., 6, p. 215).

Experiments with grass and clover, R. L. BENNETT and G. B. IRBY (*Arkansas Sta. Rpt. 1894, pp. 127–136*).—A reprint from Bulletin 29 of the station (E. S. R., 6, p. 531).

Grasses and forage plants, S. M. TRACY (*Mississippi Sta. Rpt. 1893, pp. 28–30*).—Conclusions are given drawn from experiments detailed in Bulletin 20 of the station (E. S. R., 4, p. 248) and Farmers' Bulletin 18 of the U. S. Department of Agriculture (E. S. R., 6, p. 294).

Grasses and forage plants, C. H. SHINN (*California Sta. Rpt. 1893 and 1894, p. 393*).—A number of the forage plants failed to germinate and others were killed by drought and north winds. The following species were successfully grown: Japanese rye grass, Hungarian brome grass, *Digitaria sanguinalis*, velvet grass, perennial rye grass, redtop, teosinte, *Phalaris media*, canary grass (*P. canariensis*), *Lotus tetragonalobus* and *Melilotus alba*.

Hay from barley, wheat, and oats, C. H. SHINN (*California Sta. Rpt. 1893 and 1894, pp. 374, 375*).—Tabulated data and notes on the yield of hay at the Foothills Substation.

A comparison of black Siberian lupines with other species, C. SCHRAPE (*Fühling's landw. Ztg., 44 (1895), No. 3, pp. 80–82*).—This excelled in yield and contained a smaller amount of alkaloids than other species.

Black medick (Medicago lupulina), E. WILCZEK (*Chron. Agr. Cant. Vaud, 8 (1895), No. 4, pp. 82–84*).—At Zurich black medick from Germany gave a larger yield of forage, produced larger leaves and seeds, and proved hardier, but was later in reaching maturity than seed from Germany.

Experiments with flat pea, sachaline, and Trifolium pannonicum, E. WILCZEK (*Chron. Agr. Cant. Vaud, 8 (1895), No. 2, pp. 24, 25*).—Ordinary meadow mixtures exceeded in productiveness flat pea aged 1, 2, and 3 years; on dry, rocky declivities the latter proved valuable. Sachaline is not commended. *Trifolium pannonicum* is hardy and productive, but makes only a slow growth.

On the composition of certain French and foreign oats of the crops of 1893, BALLAND (*Compt. Rend., 120 (1895), No. 9, pp. 502–504*).

The origin of the potato (*Rev. Scientif., 3 (1895), ser. 4, No. 8, p. 258*).

Variety tests of potatoes, H. PETTWEILER (*Deut. landw. Presse, 22 (1895), No. 12, pp. 102, 103*).

The best varieties of potatoes, VON ECKENBRECHER (*Jahrb. deut. landw. Ges., 9 (1894), pp. 290–303*).—A report on prize varieties.

The influence of the removal of the lateral eyes of the seed tubers upon the growth and productiveness of the potato plant, E. WOLLNY (*Forsch. Geb. agr. Phys., 17 (1894), No. 5, pp. 461–473*).

The second crop of Irish potatoes, C. L. NEWMAN (*Arkansas Sta. Rpt. 1894, pp. 96–100*).—A reprint from Bulletin 28 of the station (E. S. R., 6, p. 409).

Potato culture, (*Amer. Agr. (middle ed.), 1895, Feb. 16, Feb. 23, Mar. 2, Mar. 9, Mar. 16, pp. 164, 196, 221, 252, 281*).—This is a series of articles based upon the results of a "potato contest" in 1889 and 1890, and giving general conclusions relative to soil, preparation, fertilization, seed potatoes, varieties, and cultivation.

Experiments with rye, C. L. NEWMAN (*Arkansas Sta. Rpt. 1894, pp. 90–93*).—A reprint from Bulletin 28 of the station (E. S. R., 6, p. 411).

Sugar beets (*New Jersey Stas. Rpt. 1893, pp. 155–157*).—A brief statement of the method of cultivating sugar beets in Cape May County, and analyses of 8 varieties of sugar beets.

The sugar content of sugar beets which have developed seed stalks, G. DE MARNEFFE and O. CASTEELS (*Ingén. Agr. Gembloux, 5 (1895), No. 8, pp. 351–354*).

Effect of manuring beets and other roots with potash salts (*Deut. landw. Presse, 22 (1895), No. 9, pp. 74, 75*).

Sugar beets and sugar cane, M. E. JAFFA (*California Sta. Rpt. 1893 and 1894, pp. 218, 219*).—Analyses of sugar beets from 4 localities and of 1 sample of sugar cane are tabulated.

The nitrogen content of sugar cane, LOOKEREN-CAMPAGNE (*Deut. Zuckerind., 20 (1895), p. 22; abs. in Chem. Ztg., 19 (1895), No. 10, p. 28*).

Sorghum and sugar cane, S. M. TRACY (*Mississippi Sta. Rpt. 1893, pp. 25, 26*).—Brief notes on varieties of sorghum grown at the station in 1889 and 1890, and on a fertilizer test for sugar cane.

Sorghum, perennial cotton, sugar cane, and cereals, C. H. SHINN (*California Sta. Rpt. 1893 and 1894, pp. 419, 420*).—Brief references are made to all of these crops cultivated at the Southern California Substation. Perennial or Catacaos cotton bloomed in November and December and was killed to the root by light frosts. Reference is made to the special value of a tract of moist land belonging to the substation and a list of grasses sown in 1893–'94 is given.

Notes on culture of tobacco in Virginia, R. H. GAINES (*Southern Planter, 56 (1895), No. 3, pp. 107, 108*).—Continued.

Fertilizers for tobacco, H. J. PATTERSON (*Southern Planter, 56 (1895), No. 3, pp. 109, 110*).—A summary of results of experiments, particularly those of the Maryland station, already reported in Bulletin 26 of that station (E. S. R., 6, p. 209).

Wheat, barley, and sorghum, C. H. SHINN (*California Sta. Rpt. 1893 and 1894, pp. 410, 411*).—The yields of 13 varieties of wheat are tabulated. Himalaya barley, an early and productive variety tested at the station, is recommended as a profitable variety for hog raisers. Nepaul barley, which is beardless, has large and heavy heads and palatable straw and is highly recommended for hay. The report contains a brief note on sorghum.

Fertilizer experiments with wheat, A. PASQUINALI and A. SINTONI (*Staz. Sper. Agr. Ital., 28 (1895), No. 1, pp. 27–42*).

Varieties of winter wheat, F. HEINE (*Deut. landw. Presse, 22 (1895), No. 6, pp. 47, 48*).

Experiments with wheat, R. L. BENNETT and G. B. IRBY (*Arkansas Sta. Rpt. 1894, pp. 115–126*).—A reprint from Bulletin 29 of the station (E. S. R., 6, p. 538).

Late crops for overflow land, R. L. BENNETT and G. B. IRBY (*Arkansas Sta. Rpt. 1894, pp. 53–61*).—A reprint from Bulletin 27 of the station (E. S. R., 6, p. 212).

Rotation experiments, R. L. BENNETT and G. B. IRBY (*Arkansas Sta. Rpt. 1894, pp. 68–70*).—A reprint from Bulletin 27 of the station (E. S. R., 6, p. 217).

HORTICULTURE.

Electro-horticulture, F. W. RANE (*West Virginia Sta. Bul. 37, pp. 27, figs. 9*).—Detailed notes on experiments for testing the effect of incandescent electric light on plants grown in greenhouses. Incandescent lamps were used in preference to arc lights even in opal globes, as giving a much steadier and cheaper light, casting no sharp shadows. The experiments were carried on during the seasons of 1892–'93 and 1893–'94, 3 greenhouses being used for the purpose. The light was furnished by one 16-candlepower lamp and by a cluster of 7 lamps of the same strength, which could be used in various combinations. Usually the light was turned on during the entire night. Lettuce, endive, beets, radishes, spinach, cauliflower, and various ornamental plants were selected to be used in the experiment, the choice being partially governed by those already tried under the arc light. The same varieties used were also planted in an ordinary greenhouse unlighted at night as a check.

Of lettuce the varieties Grand Rapids, Hanson, and Tennis Ball gave, respectively, one sixth, one fourth, and one eighth greater yield by weight in the lighted house than that grown without the aid of electricity. Spinach and cauliflower also made an improved growth in the lighted house, but beets and radishes made a smaller growth in both houses. In 1893–'94 peas and beans were also planted, and, while irregularities in subirrigation affected the results with the beans, the peas proved better in the lighted house. Radishes, on the contrary, this year were far better in the dark house, earlier, with smaller tops and larger roots; but it is believed that a greater amount of moisture in the dark house was an important element in the difference. Various potted ornamental plants blossomed earlier under light.

The experiments are given in detail and illustrated from photographs showing various plants at different stages of growth in both the light and dark houses.

A résumé is given of experiments with electric light elsewhere, especially those of L. H. Bailey at the Cornell Station.

The following summary is given:

"(1) The incandescent electric light has a marked effect upon greenhouse plants.

"(2) The light appears to be beneficial to some plants grown for foliage, such as lettuce. The lettuce was earlier, weighed more, and stood more erect.

"(3) Flowering plants blossomed earlier and continued in bloom longer under the light.

"(4) The light influences some plants, such as spinach and endive, to quickly run to seed, which is objectionable in forcing these plants for sale.

"(5) Proper watering appears to be more important with radishes, beans, and cuttings than improper watering and the electric light.

"(6) The stronger the candlepower the more marked the results, other conditions being the same.

"(7) Most plants tended toward a taller growth under the light.

"(8) It is doubtful whether the incandescent light can be used in the greenhouse from a practical and economic standpoint on other plants than lettuce and perhaps flowering plants, and at present prices it is a question if it will pay to employ it for even these.

"(9) There are many points about the incandescent electric light that appear to make it preferable to the arc light for greenhouse use."

Report of the horticulturist, M. H. BECKWITH (*Delaware Sta. Rpt. 1893, pp. 132–152*).—This contains remarks on the testing of tomatoes and strawberries, notes on raspberries, determination of the vitality of peach seed, and pollination of the peach.

Notes are given on 63 varieties of tomatoes and 94 of strawberries, with the dates of ripening, and in the case of the latter of blooming, also. In addition, special comparative notes are given for the majority of the varieties tested. The Older and a new seedling black raspberry were tested, as also the Japanese wineberry, which is considered very productive and of excellent quality.

In response to inquiries on the subject, the question of some method for determining the vitality of peach seeds, either by the appearance or some other means requiring less time than actual germination, was taken up, and suspicious seed and a circular letter were sent to a number of nurserymen believed to be authorities on the subject. The responses received from 14 correspondents are given, showing great variance of opinion. Plump, aromatic kernels are considered the freshest, but the germination test is regarded as the most reliable one.

In an experiment to test the self-pollenizing powers of different varieties of peaches, 493 unopened blossoms of 12 varieties were covered with paper bags during the blooming season, the number varying in the different varieties. Of these, 16 set fruit. The 4 varieties, Fox, Oldmixon, Smock, and Wager, set 1 fruit each, while Crawford Early set 2, and Moore Favorite, 10.

An experiment begun with cross-pollination of peaches in a private orchard was not satisfactorily reported upon and was therefore inconclusive.

Experiments with fertilizers on asparagus (*New Jersey Stas. Rpt. 1893, p. 116*).—Notes on the growing of the variety Barr Mammoth on 3 acres of sandy loam, manured with commercial fertilizers. The plants were set in 2½-ft. rows, and a mixture of nitrate of soda, ground bone, boneblack, superphosphate, and potash applied along the rows in April. In May a second application was made. The experiment is to determine the profits to be gained by the best cultivation and most careful manuring.

Fertilizer and canning test of sugar corn, A. T. NEALE (*Delaware Sta. Rpt. 1893, pp. 21, 22*).—Notes on an inconclusive and unfinished investigation as to the best method of obtaining the largest possible crop of sugar corn of the most desirable quality and the largest possible tonnage of fodder in keeping with the crop of ears and its quality. The varieties Stowell Evergreen and Zig-Zag were employed in the experiment, in which 24 plats were manured with different combinations of fertilizers. At the close of the experiment a case of corn from each of the plats was packed in a cannery and tested by experts as to its commercial value. The experiment is to be resumed.

Sweet potatoes, H. N. STARNES (*Georgia Sta. Bul. 25, pp. 127–161, pl. 1, figs. 35*).

Synopsis.—Experiments conducted at the station in 1893 and 1894 consisted of a fertilizer test, ridge *vs.* level cultivation, pruning the vines, moving the vines, distance experiments, and tests of varieties. The results favored a fertilizer containing potash, cotton-seed meal, and either superphosphate or soft phosphate. Ridge cultivation proved better in 1893 and level cultivation in 1894. Pruning and moving the vines both reduced the yield. A distance of 18 in. between the plants gave the largest yield. The most productive variety was White St. Domingo. Directions for the culture and storage of sweet potatoes are given.

In both years complete fertilizers largely increased the yield. In 1893, 320 to 325 lbs. of kainit and 80 to 81 lbs. of muriate of potash gave practically as good results as larger quantities. In 1893 kainit proved slightly superior to muriate of potash, and cotton-seed meal to nitrate of soda. In 1894 when Florida soft phosphate was compared with acid phosphate the yields were practically identical with the 2 fertilizers. "This can only be accounted for by the assumption that the potato is decidedly indifferent to either."

In 1893 the difference in favor of ridge over level culture was 35.67 bu. per acre. In 1894 the difference in favor of level culture was 33.1 bu., the latter season being dry soon after the plants were set and during September. The variety Pumpkin Yam when undisturbed yielded 201.3 bu.; when pinched weekly to 2 ft. throughout the season, 104.9 bu.; when pinched weekly after September 1 to 2 ft., 50.1 bu.

When the vines were not allowed to root the yield was 156.3 bu. per acre; when undisturbed the yield was 270.3 bu.

In 1893 at distances of 12, 24, and 30 in. between the plants in the row the yields were respectively 267.62, 237.08, and 229.75 bu. per acre. When 2 slips were inserted together at distances of 18 in. the yield was greater than when 1 slip was used either 18 or 9 in. apart. Thirty-three varieties are described and figured and their yields are tabulated. The largest yields were made by White St. Domingo, Shanghai or Clay, Boone White, and Hayman.

"The slit-leaf varieties are much the most productive. . . . They are also generally characterized by bright yellow flesh (when cooked), fineness of fiber, and delicacy of flavor. They are also as a rule excellent keepers. . . . The best potato in point of quality is the Georgia Yam, but it is unproductive. The best combination potato is probably the Tennessee Yam. It is of excellent quality and quite productive."

The composition of sweet potatoes, M. E. JAFFA and M. CURTIS (*California Sta. Rpt. 1893 and 1894, pp. 219–225*).—Seventeen varieties of sweet potatoes grown at the Pomona Substation were analyzed. The average results for the 17 varieties are given in the table below, which for comparison also contains the average results of 21 varieties grown at the Texas Station.

Analysis of sweet potatoes.

	California.	Texas.
	Per cent.	*Per cent.*
Water	70.00	70.00
Ash	1.08	1.14
Protein	1.86	2.41
Fat	.95	.99
Total sugar	5.71	6.81
Nitrogen-free extract	23.60	24.00
Fiber	2.51	1.26

Sweet potatoes grown in Texas were richer in protein and sugar, while those grown in California contained a larger percentage of fiber. Of the 17 varieties grown in California, Bermuda contained the highest percentage of protein, 3.08 per cent, and Vineless the second largest percentage, 2.28. Barbadoes gave the largest content of total sugar, 11.55 per cent, and Red Nansemond the minimum. The varieties differed but slightly in the percentage of nitrogen-free extract.

Irish and sweet potatoes are compared with reference to their nutritive value. The potential energy in 1 lb. of Irish potatoes is calculated as 375; in 1 lb. of sweet potatoes, 537.

An analysis is given of the ash of sweet-potato roots, and on the basis of this analysis it is calculated that a crop of 5,000 lbs. of roots removes from the soil 31.4 lbs. of potash, 8.75 lbs. of phosphoric acid, and 15 lbs. of nitrogen.

Fertilizer experiments with sweet potatoes (*New Jersey Stas. Rpt. 1893, pp. 125–136*).—On a fertile soil in Gloucester County, manured the preceding year with 18 tons of barnyard manure, a sweet potato experiment was conducted on twentieth-acre plats in 1893. Mixed

minerals (boneblack 120 lbs. and muriate of potash 160 lbs. per acre) were applied alone and in combination with 200 lbs. of nitrate of soda and 280 lbs. of dried blood per acre. Stable manure at the rate of 20 tons per acre was applied alone, and at the rate of 10 tons per acre in connection with half the quantity of commercial fertilizers indicated above. On 2 plats the amounts of commercial fertilizers were increased 50 per cent. The following table gives the yield of sweet potatoes, and the percentage of large potatoes in the crop:

Yield per acre of sweet potatoes differently fertilized.

	Total.	Large.	Small.	Large.
	Bushels.	*Bushels.*	*Bushels.*	*Per cent.*
Unfertilized	181.9	111.9	70.0	61.5
Minerals alone	235.2	170.6	64.6	72.5
Minerals and nitrate of soda	228.0	169.3	58.7	74.3
Minerals and dried blood	203.1	144.2	58.9	71.0
Barnyard manure	225.2	170.9	54.3	75.9

On this rich and well fertilized soil both nitrate of soda and dried blood proved unprofitable, the former, however, giving a yield superior to the latter. Increasing the commercial fertilizers by 50 per cent failed to increase the yield.

Reckoning large potatoes at 70 cts. per bushel and small potatoes at 50 cts., non-nitrogenous minerals alone gave a net profit of $30.68 per acre; non-nitrogenous minerals with nitrate of soda $26.37; non-nitrogenous minerals with dried blood $5.38; stable manure alone a net loss of $6.57; half rations of chemicals and manure a gain of $5.36, and whole rations of manure and chemicals a loss of $20.90.

The results of an experiment at Vineland, New Jersey, are also tabulated, although damage from drought prevented the drawing of conclusions.

Experiments with fertilizers on tomatoes (*New Jersey Stas. Rpt. 1893, pp. 103–119*).—Details and results of an experiment on the value of nitrate of soda in varying amounts, both alone and in different combinations with boneblack and muriate of potash. Twelve twentieth-acre plats were employed, 2 of them being left unfertilized and another treated with barnyard manure, as checks. To some of the plats all of the nitrate of soda was applied at once, and to others 2 applications were made, 3 weeks apart. The tomatoes matured more quickly and gave a greater proportion of early fruit on the plats receiving nitrate of soda. Other results were as follows:

"(1) Nitrate of soda is superior to both barnyard manure and mineral fertilizers alone.

"(2) Nitrate of soda alone is on the whole but slightly less effective than the complete manure.

"(3) When small quantities of nitrate are used the second application is advantageous; and

"(4) Large quantities (320 lbs. per acre) of nitrate are more effective than small quantities (160 lbs. per acre)."

Six tables are given, showing the features of the experiment in detail, the fertilizers applied, the dates of ripening, the relation of the early tomatoes to the entire crop, comparisons of the results from different fertilizers, ratios of the yield and market value, and other points.

Percentages of flesh, juice, and nutrients in the fresh edible portion of some California fruits, G. E. COLBY (*California Sta. Rpt. 1893 and 1894, pp. 271-274*).—Brief notes and tabulated data drawn from a number of analyses of different fruits. The fig is placed first in respect to protein, followed closely by the grape, and the nectarine last. The extremes of sugar content are found in fresh prunes and lemons. The results are shown in the accompanying table:

Amount and composition of the edible portion of some California fruits.

Fruits.	Number of analyses.	In whole fruit.		In edible portion.				
					Nutrients.			
		Flesh.	Juice, pressed.	Water.	Protein (N. x 6.25).	Fat, fiber, and carbohydrates, less sugar.	Sugar.	Mineral matters (ash).
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Oranges	13	73.0	52.00	88.30	.760	[1] 3.840	7.10	....
Lemons[2]	22	71.0	45.50	....	....	....	1.63	....
French prunes	10	94.2	74.20	75.15	.944	3.641	19.70	.565
All prunes	20	94.2	74.20	80.20	.848	2.368	16.11	.474
Plums	3	95.2	71.00	78.40	.996	6.833	13.25	.524
Apricots	11	93.9	84.50	85.07	1.042	1.477	11.93	.477
Nectarines	1	93.4	85.00	82.90	.625	.855	15.13	.490
Figs	28	100.0	77.65	79.11	1.522	3.261	15.53	.577
Grapes	3	100.0	79.00	80.12	1.256	1.624	16.50	.500

[1] Contains the ash.
[2] The whole fruit yields: Water, 85.04 per cent; organic matter, 14.42 per cent; ash, 0.535 per cent; nitrogen, 0.152 per cent (corresponds to 0.95 per cent protein).

The ash analyses of various fruits reported in several previous bulletins are summarized, and a table is given showing the distribution of the various constituents in different fruits. Figs gave the most ash, 28 samples showing an average of 0.577 per cent, while the orange gave the least, 0.432 per cent. Potash was found to make up from one half to two thirds the whole ash, being the greatest, 63.83 per cent, in the prune, and least in oranges and lemons, 48 per cent. Soda was found to vary from 10.26 per cent in apricots to 1.76 per cent in lemons. The greatest variation was in lime, of which the ash of the lemon contained 29.87 per cent and that of the apricot 3.17 per cent. The percentage of phosphoric acid was found to be quite constant in the majority of the ashes, ranging from 11.9 per cent in lemons to 14 per cent in prunes. Grape ash, however, contained a high proportion of phosphoric acid, 21.24 per cent. The others, minor ingredients, are rated as unimportant and rather uniform. Silica, however, ranges from 0.65 per cent in the ash of citrus fruits to 5.2 per cent in that of apricots and grapes.

Fruit and fruit soils in arid and humid regions, E. W. HILGARD (*California Sta. Rpt. 1893 and 1894, pp. 327–334*).—A discussion of the results of analyses of a number of soils from arid and humid regions and of fruits grown on these different soils. Tables are given showing the average of analyses of 466 humid and 313 arid soils, and the albuminoids, sugar, acid, and ash of various California fruits. In all the fruits examined, except the orange, the nutritive value is greater than in the analyses of the like European fruits, the increase in some instances being as much as 50 per cent. More extended and careful study of the subject is urged.

Analyses of bananas and banana soils from the Sandwich Islands, G. E. COLBY (*California Sta. Rpt. 1893 and 1894, pp. 275–279*).—Tabulated results of the analyses of 2 samples of soils from Honolulu, made to determine their requirements in the way of fertilizers for bananas. In addition, leaves and fresh fruit of the banana were analyzed to learn the ingredients drawn by them from the soil. It is calculated that an average 80-lb. bunch of bananas extracts 0.55 lb. of muriate of potash. Potash salts or kainit, and Chile saltpeter, dried blood, or some other nitrogenous fertilizer, and lime in the shape of coral sand, are recommended. As chlorin is needed a dressing of salt is also suggested.

Analyses of California oranges and lemons, G. E. COLBY (*California Sta. Rpt. 1893 and 1894, pp. 240–256*).—This comprises descriptive notes upon citrus fruits, tabulated proximate analyses of 32 samples of oranges, 18 of lemons, and 1 of pomelo, and is a continuation of the work presented in Bulletin 93 of the station (E. S. R., 3, p. 78). Tables are given showing the results of analyses in detail.

The Navel orange was found to be the largest, but the large proportion of rind, 28 per cent, gave it little if any advantage on account of its size over smaller oranges with thinner rinds. The varieties St. Michael and Tardive possessed only 20 per cent of rind. The Navel was also the driest orange, and the two others mentioned the juiciest, though closely followed by Medium Sweet, Malta Blood, and some seedlings. The King orange, of which but 3 specimens were analyzed, contained the most sugar, 13.17 per cent, being followed closely by seedlings and Navels. The largest amount of acid was found in a sample of Malta Blood, 2.04 per cent, and least in the Mandarin. The Navel also possessed little acid.

The lemons analyzed showed an average of 24.8 per cent rind, which is lower than was found the two years previous. The highest per cent of acid was 8.40 in Royal Messina, in which the juice was 55 per cent of the whole. The highest sugar content was 3.46 per cent, also in Royal Messina.

Analyses of the pomelo gave 2.7 per cent of citric acid and 9.5 per cent of sugar, cane sugar comprising 5 per cent.

The following table shows the average percentages of sugar and acid in various samples of several varieties of oranges analyzed in 1885 and 1891-'93:

Average percentages of sugar and acid.

Variety.	No. of samples.	Sugar.	Acid.
Navels	16	10.46	0.97
Seedlings	12	11.11	1.17
Mediterranean Sweets	8	9.55	1.75
St. Michaels	13	9.65	1.16
Malta Blood	6	10.10	1.41
Ruby Blood	3	11.08	1.51
King	3	13.17	1.49
Tardive (Valentia Late)	2	9.98	1.00

Hastened energy, a new theory, J. H. WATKINS (*Proc. Ga. Hort. Soc. 1893, pp. 62-66*).—This paper deals with experiments conducted to ascertain the effect of planting immature or prematurely ripened fruit seeds. Peaches were chiefly employed in the experiment. It was found that seeds planted from hastily ripened fruit possessed a low degree of vitality and a large percentage would not germinate. Such seedlings as grew produced fruit much earlier than did the parent tree, and in many cases of improved quality.

Field experiments with fertilizers on peach trees (*New Jersey Stas. Rpt. 1893, pp. 138-143*).—Notes on a continued experiment begun in 1884 on a private farm. Potash, either alone or in combination, has given the best results, while nitrate of soda appears to have exerted an unfavorable influence, except when used in connection with superphosphates.

Notes are also given for an experiment just commenced on another farm to test the effect of overfertilizing fruit trees, and the effect of nitrogen and phosphoric acid supplied in different ways, in one case by means of nitrate of soda and boneblack, and in another by ground bone and ground fish. In both cases potash is given as muriate of potash. On each of the fertilized plats the yield in 1893 was more than on an unfertilized plat.

Soil tests with fertilizers used on peach trees, A. T. NEALE (*Delaware Sta. Rpt. 1893, pp. 13-16*).—Notes and tables showing the results of experiments conducted on 2 private farms to ascertain the value of the several soils and the fertilizers required by each. Both nitrogenous and potash fertilizers gave favorable results, but the best returns were found when the two styles of fertilizers were combined. Crimson clover is regarded as a valuable fertilizer. Mountain Rose, Crawford Early, and Foster were the varieties of peaches used in the test, which has been conducted 3 years and is to be continued.

Orchard fruits, C. H. SHINN (*California Sta. Rpt. 1893 and 1894, pp. 364-373*).—Notes on the orchard work conducted at the California Foothill Station at Jackson, Amador County. This comprises comparative and cultural notes on the various varieties of apples, almonds, apricots,

plums, prunes, cherries, nectarines, pears, and peaches. Several of the different kinds of fruits are planted on both red soil and granite soil to determine their relative value. Although in other places the granite soil is condemned, here it is found well adapted to many trees, responding rapidly to proper fertilizers. Tabulated data are given showing the dates of blooming and ripening of 62 varieties of peaches and the order of ripening of 17 leading varieties is compared with that of the same varieties in the valley of Alameda County. There is a well-marked difference, showing the preference in different varieties for different altitudes.

Orchard fruits at Paso Robles, C. H. SHINN (*California Sta. Rpt. 1893 and 1894, pp. 380–392*).—Comparative and cultural notes on the orchard at the California Southern Coast Range Substation, data being given for 32 varieties of cherries, 13 of almonds, 49 of peaches, 9 of nectarines, 11 of apricots, 21 of plums and prunes, and several of apples, pears, olives, walnuts, chestnuts, quinces, mulberries, and figs. The work in the vineyard is mentioned, and notes given on 3 varieties of gooseberries and on the Logan berry.

Orchard fruits at San Joaquin Valley Station, C. H. SHINN (*California Sta. Rpt. 1893 and 1894, pp. 404–410, pl. 1*).—Notes, chiefly cultural, on the orchard at this California substation, especially in regard to the methods of correcting the alkali soil, for which purpose gypsum has been found most valuable. Tabulated data are given for 10 varieties of apples, 18 of apricots, 3 of almonds, 10 of nectarines, 45 of peaches, 13 of pears, and 28 of plums and prunes. An engraving from a photograph is given showing the weakness of pear trees grown on strong alkali soil as compared with those on soil possessing less alkali.

Orchard fruits at the South California Substation, C. H. SHINN (*California Sta. Rpt. 1893 and 1894, pp. 416–419*).—Brief notes on the orchard at this substation, which is making a fine growth, although so young that the yield is small. Notes are given on olives, lemons, oranges, almonds, cherries, peaches and nectarines, apricots, plums and prunes, pears, apples, figs, grapes, and walnuts and chestnuts.

The Logan berry, E. J. WICKSON (*California Sta. Rpt. 1893 and 1894, p. 340, pl. 1*).—Illustrated descriptive notes on this peculiar rasp-blackberry cross, which, in the station grounds, has proved to be a robust grower, with large handsome fruit, possessing a striking flavor suggestive of a combination of that of raspberries and blackberries. The plant appears to be free from all kinds of leaf diseases.

Notes on strawberries for 1894 (*New York State Sta. Bul. 76, pp. 429–444, pl. 1*).—Descriptive and cultural notes and tabulated data for 75 varieties of strawberries fruited on the station grounds for the first time. They were grown in matted rows on stiff clay loam, tile drained, and fertilized with barnyard manure. They were given one cultivation in the spring and mulched 4 or 5 in. deep with straw during the winter.

A table of productiveness showing also the season of ripening is given for 27 varieties, of which Allen No. 5 and Hayne No. 31 lead, with yields of 312 oz. and 283 oz., respectively, from 33 sq. ft. of ground. See No. 2 ranks third, with a yield of 196 oz. Of varieties ripening before June 21 and termed early, See No. 1 was the most productive. Of 10 late varieties, Station No. 198 gave the greatest yield after July 3. One hundred and sixty-four varieties of strawberries were grown at the station during the year, exclusive of several hundred varieties of station seedlings. The work at the station in breeding strawberries for the purpose of originating new varieties is mentioned.

Experiments with fertilizers on strawberries (*New Jersey Stas. Rpt. 1893, pp. 143–145*).—Notes on fertilizing 2 plats of strawberries with nitrate of soda, ground bone, and kainit. In addition 1 plat received nitrate of soda each spring. The latter plat gave an increase in yield of about 20 per cent.

The ash of grapes, F. T. BIOLETTI (*California Sta. Rpt. 1893 and 1894, pp. 322–326*).—Notes and tabulated data on the analyses of the ash of 5 samples of grapes and raisins and 1 of wine, to gain information as to the amount of soil ingredients taken from the ground and the fertilizers needed by the crop. The results are compared with those obtained from analyses in Europe and found to be much the same, the California analyses, however, showing a higher percentage of soda and a lower percentage of lime than was found by the European analyses. This is accounted for by the difference of soil, the California grapes being grown in rich interior valleys where the soil contained much potash and soda. As the phosphoric acid taken from the soil is proportionately large in amount, phosphatic manures are recommended, and the popular belief that the application of such manures to vineyards will communicate bad odors to wine is declared to be erroneous.

The following table shows the results of the analyses compared with those of wheat as regards the fertilizing ingredients taken up:

Ingredients abstracted from the soil.

	Total ash.	Potash.	Phosphoric acid.	Nitrogen.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
5 tons of grapes per acre, average of 5 California analyses	50.00	25.48	10.62	12.60
5 tons of grapes per acre, average of 3 German analyses	50.00	25.07	10.50	17.00
Wheat hay (Johnson), 4,800 lbs per acre	246.00	43.92	19.80	42.00
Wheat (Johnson), 20 bu. per acre	24.00	7.85	11.90	24.00
Wine (Mataro, from Santa Clara County), 800 gal. per acre	15.37	6.07	2.30	.64

Cassava, J. H. HART (*Roy. Bot. Gard. Trinidad, Misc. Bul., 2 (1895), No. 1, pp. 25–27*).—Remarks on analyses of bitter and sweet cassava, showing that the nonpoisonous variety apparently does not exist in Trinidad. It is believed that the amount of prussic acid in sweet cassava is nearly equal to that in the bitter, and that too much confidence has been used in attributing non-poisonous properties to the sweet cassava. Careful boiling of sweet cassava in two or three waters is advised to expel all of the volatile prussic acid.

Castor beans, S. M. TRACY (*Mississippi Sta. Rpt. 1893, pp. 26, 27*).—Brief notes on crops grown in 1892 and 1893. An obscure blight caused the failure of this crop.

Echinocystis lobata, E. ANDRÉ (*Rev. Hort., 67 (1895), No. 1, pp. 9, 10, fig. 1*).—A description of this American curcubit, which is recommended as an ornamental plant chiefly on account of its oval-shaped spiny fruits.

Wild horse-radish, G. ALLUARD (*Rev. Hort., 67 (1895), No. 3, pp. 86, 87, fig. 1*).—Notes on its collection and preparing for market, with directions for cultivation.

The leeks, G. ALLUARD (*Rev. Hort., 67 (1895), No. 1, pp. 20–22, fig. 3*).—Descriptive and cultural notes on several varieties of leeks, giving directions for their best cultivation.

Onions from seed, C. L. NEWMAN (*Arkansas Sta. Rpt. 1894, pp. 93–95*).—A reprint from Bulletin 28 of the station (E. S. R., 6, p. 419).

Salsify, C. L. NEWMAN (*Arkansas Sta. Rpt. 1894, pp. 95, 96*).—A reprint from Bulletin 28 of the station (E. S. R., 6, p. 423).

Culture and cooking of Sechium edule (*Agl. Jour. Cape Colony, 7 (1894), No. 26, p. 614*).

Varieties of sweet potatoes, C. H. SHINN (*California Sta. Rpt. 1893 and 1894, pp. 420–424*).—Twenty-one varieties of potatoes tested at the Southern California Substation are described, and for a few of these the results of cooking tests are noted.

Best forms of food for the sweet potato crop, A. W. PEARSON (*Amer. Agr. (middle ed.), 1895, Mar. 23, p. 314*).—Advises use of chemical manures applied some months before planting.

The cultivation of tomatoes on a large scale in the vicinity of Paris, G. ALLUARD (*Rev. Hort., 67 (1895), No. 2, pp. 45–47, fig. 1*).—A general article on the subject dealing with the cultural method and describing some of the varieties most in use.

A new method of etiolation, E. A. CARRIÈRE (*Rev. Hort., 67 (1895), No. 1, pp. 12, 13, figs. 2*).—Description of a method of blanching chicory and other salad plants by placing a cask over the growing plant with its sides perforated with holes to allow free circulation of air. The method is claimed to be very successful.

Truck farming on the coast lands, G. M. RYALS (*Proc. Ga. Hort. Soc. 1892, pp. 26–29*).—Notes on market gardening in the coast region of Georgia, with remarks on the preparation and fertilizing of the land, the character of seed to be used, and shipping and marketing. Celery is regarded as an especially valuable crop.

Some apples adapted to all sections of Arkansas, J. T. STINSON (*Arkansas Sta. Rpt. 1894, pp. 44–47*).—A reprint from Bulletin 26 of the station (E. S. R., 5, p. 1075).

Arkansas seedling apples and nursery stock, J. T. STINSON (*Arkansas Sta. Rpt. 1894, pp. 48–50*).—A reprint from Bulletin 26 of the station (E. S. R., 5, p. 1075).

Analyses of figs, G. E. COLBY (*California Sta. Rpt. 1893 and 1894, pp. 225–235*).—A reprint from Bulletin 102 of the station (E. S. R., 5, p. 301).

Figs at the Foothill Station, G. HANSEN (*California Sta. Rpt. 1893 and 1894, pp. 375–378*).—Comparative notes on some of the varieties of figs grown at this California substation. Fifty-two varieties are planted. The variety Hirtu du Japon is considered the best bearer. Of the white varieties White Adriat.c DuRoi, and White Marseilles; of brown, Drap d'Or and Brown Turkey; and of black, Pasteliere and Rond Noir were most satisfactory.

Figs at Tulare Station, J. FORRER (*California Sta. Rpt. 1893 and 1894, pp. 411–414*).—Descriptive and comparative notes on 39 varieties of figs grown at this substation.

The mango, J. H. HART (*Roy. Bot. Gard. Trinidad, Misc. Bul., 2 (1895), No. 1, pp. 11-13*).—Cultural notes on *Mangifera indica*, especially in reference to the soil and grafting. It is stated that if well cultivated, mangoes will produce sweet, pleasantly flavored fruit that deserves a wide reputation. The varieties cultivated at the botanic gardens are named.

The mangosteen, J. H. HART (*Roy. Bot. Gard. Trinidad, Misc. Bul., 2 (1395,) No. 1, pp. 10, 11*).—Notes on the tree and fruit of *Garcinia mangosteena*, which has been introduced from the East Indies into Trinidad, where it is growing well, and the

fruit being liked. The mangosteen possesses a thick, brittle, bitter rind, which readily cracks off, exposing the white pulp divided into quarters. Only 1 or 2 mature seeds are produced by each fruit.

Olive culture, A. P. HAYNE (*California Sta. Rpt. 1893 and 1894, pp. 298–322*).—Cultural notes for the olive, comprising remarks on pruning, curing, harvesting, and storing of the fruit and the expression of the oil. The greater part of the paper is a reprint from Bulletin 104 of the station (E. S. R., 6, p. 141).

Twig budding and grafting the olive, E. J. WICKSON (*California Sta. Rpt. 1893 and 1894, pp. 339, 340*).—A brief note on the subject, including a letter from an experienced orchardist, detailing methods employed by him in budding and grafting, which have proved most successful.

Olives and olive oil, A. P. HAYNE (*California Sta. Rpt. 1893 and 1894, pp. 279–297, pl. 1*).—Descriptive notes on the trees and fruit of 20 varieties of olives, with analyses showing the number of olives in 100 gm. and the percentage of pit, flesh, and oil in the fruit. Fifty-six varieties of olives are now planted at the various substations.

The peach palm, J. H. HART (*Roy. Bot. Gard. Trinidad, Misc. Bul., 2 (1895), No. 1, pp. 28, 29*).—Descriptive notes on *Guilielma speciosa*, which is found growing well in Trinidad. The palm usually bears two crops in a year, that in October being composed of large fruit with abortive seeds, while the other consists of small fruits with hard fertile seeds. The October fruit is boiled and eaten with salt, and is considered a very nutritious human food.

Japanese plums, L. H. BAILEY (*Rev. Hort., 67 (1895), No. 2, pp. 51, 52*).—Translated from *Gardener's Chronicle*, giving brief descriptive and comparative notes on the chief varieties of Japanese plums that have been introduced and grown in America.

Examination of California prunes, apricots, plums, and nectarines, G. E. COLBY (*California Sta. Rpt. 1893 and 1894, pp. 257–268*).—A reprint of Bulletin 101 of the station (E. S. R., 4, p. 918).

Analyses of prunes and apricots, G. E. COLBY (*California Sta. Rpt. 1893 and 1894, pp. 268–271*).—Descriptive notes on 6 varieties of prunes and 1 of apricot, with a table giving in detail the results of the proximate analyses. The sugar content in all the instances was below that determined by previous analyses. French prunes possessed the most sugar, 13.95 per cent.

Catalogue of the fruit trees at the California Experiment Stations (*California Sta. Rpt. 1893 and 1894, pp. 474–490*).—This comprises long lists of the varieties planted at the central station and at 4 substations, there being given 274 varieties of apples, 18 of crab apples, 23 of almonds, 48 of apricots, 40 of cherries, 5 of chestnuts, 2 of citron, 68 of figs, 6 of lemons, 10 of mulberries, 17 of nectarines, 20 of oranges, 169 of peaches, 166 of pears, 120 of plums and prunes, 7 of persimmons, 8 of quinces, and 19 of walnuts.

Fruit culture in north Georgia, J. C. MILLER (*Proc. Ga. Hort. Soc. 1892, pp. 68–70*).—General remarks on fruit growing in northern Georgia, the author believing that fruits can be produced here equal to those grown in California.

Catalogue of Georgia fruits (*Proc. Ga. Hort. Soc. 1892, pp. 71-86; 1893, pp. 69-85*).—An annotated list and tabulated data for various kinds of fruit successfully cultivated in Georgia, the State being divided into 4 sections, the upper or mountain, the middle, the southern, and lower or coast region.

Fruits of Bohemia, F. THOMAYER (*Rev. Hort., 67 (1895), No. 1, pp. 17, 18*).—Historical notes on several varieties of apples, peaches, and other fruits which have been originated in Bohemia, which has for centuries been noted for its orchards and its production of valuable varieties of fruits.

Fruit culture in Gironde, C. GÉRAND (*Rev. Hort., 67 (1895), No. 4, pp. 74-76*).—Short articles giving the status of fruit growing in this Department, with lists of the preferred varieties.

Various methods of soil improvements in orchards, N. SCHNEIDER (*Rev. Hort., 67 (1895), No. 1, pp. 22-25; No. 2, pp. 48-50*).—General remarks on the subject dealing with manuring and tilling the ground.

An implement for vine grafting, E. ANDRÉ (*Rev. Hort., 67 (1895), No. 4, pp. 67, 68, fig. 1*).—Illustrated description of an apparatus for cutting the stems of grape vines in making various kinds of grafts.

Notes on pruning deciduous fruits, W. H. TYSON (*California Sta. Rpt. 1893 and 1894, pp. 397-400*).—General remarks on the subject and special directions as to the proper pruning to be given almonds, apricots, prunes, apples, pears, cherries, and peaches. Severe pruning is advised for most cases, low, round heads to be established.

The effect of pruning and training on the natural habits of the grape, S. D. RIEGEL (*Proc. Ga. Hort. Soc. 1892, pp. 32–34*).—General notes on the subject, with a discussion of the respective value of various systems. Fuller's oblique training is recommended for trellises, and the serpentine system for stakes. Intelligent pruning is urged.

Earliness vs. quality in fruits, S. HAPE (*Proc. Ga. Hort. Soc. 1892, pp. 67, 68*).—A short popular paper urging that early fruits are apt to be immature and possess little or insipid flavor.

Transportation of fruits and vegetables, W. L. GLESSNER (*Proc. Ga. Hort. Soc. 1893, pp. 26–28*).—A general discussion of the problem of the transportation of horticultural products, picking, packing, and shipping being in turn considered. Care in icing the refrigerator cars is urged.

Canning vegetables and fruits (*Amer. Agr. (middle ed.), 1895, Mar. 5, p. 252*).—Tabulated data give the results obtained at a California cannery regarding the number of pounds of each fruit and vegetable required to make 100 lbs. of canned goods, amount of sugar required, and cost of labor in canning.

Canning, drying, and preserving fruit, A. H. BENSON (*Agl. Gaz. N. S. W., 5 (1894), No. 12, pp. 857–866*).

A new process of preparing raisins, A. PETIT (*Rev. Hort., 67 (1895), No. 1, pp. 69, 70*).—A brief description of a scheme of curing raisins by exposing them to an atmosphere of alcohol vapor at 60° F. for 2 months.

Report of horticulturist (*Mississippi Sta. Rpt. 1893, pp. 33–37*).—A report on the horticultural work of the station, strawberries and grapes having received most attention, and being treated of at greatest length. Cultural notes are given for these fruits. The horizontal trellis is preferred for training grapevines. Cottonseed hulls are recommended as mulch and fertilizer for strawberries, and ashes for fertilizing grapes. Lists of the preferred varieties of strawberries and grapes are given.

FORESTRY.

The chestnut in the West, C. A. KEFFER (*Garden and Forest, 8 (1895), p. 83*).

The honey locust in the West, C. A. KEFFER (*Garden and Forest, 8 (1895), p. 112*).—The tree has flourished very well on the dry uplands of western Kansas, although a failure at the South Dakota Station.

Notes on the distribution of the yellow pine in Nebraska, C. E. BESSEY (*Garden and Forest, 8 (1895), pp. 102, 103*).

Species of cork-forming trees, H. MAYR (*Centbl. Ges. Forstw. Wien, 21 (1895), No. 2, pp. 55–57*).—The author enumerates *Ulmus suberosa, Acer campestre, Euonymus europæus, Fraxinus anomala, Xanthoxylum clava-hercules, Quercus suber, Q. occidentalis*, etc.

The lesson of the forest fires, B. HUBBARD (*Pop. Sci. Monthly, 1895, Mar., pp. 586–596*).

The forestry stations, C. H. SHINN (*California Sta. Rpt. 1893 and 1894, pp. 425–432*).—A brief history of the establishment and a report on the present condition of the forestry stations at Chico and Santa Monica are given.

SEEDS—WEEDS.

Distribution of seeds, plants, cuttings, etc., E. J. WICKSON (*California Sta. Rpt. 1893 and 1894, pp. 343–362, fig. 1*).—A report is given of the distribution by the station of seeds, plants, cuttings, etc., since 1890, the details of the offerings having appeared in Bulletins 95, 98, and 103 of the station (E. S. R., 3, p. 444; 4, p. 557; 5, p. 683). Statistics are given of the distributions since 1886, showing that there were sent out 52,310 plants and cuttings and 40,457 ounces of seed. Brief reports are given by the voluntary experimenters on the materials sent out. A list of donations to the station since December, 1892, is appended.

Some Oregon weeds, M. CRAIG (*Oregon Sta. Bul. 32, pp. 99–116, figs. 9*).—The author gives illustrated descriptive notes on 5 troublesome weeds, as follows: Canada thistle (*Cnicus arvensis*), bull thistle (*C. lanceolatus*), sow thistle (*Sonchus arvensis*), spiny or dagger cockle bur (*Xanthium spinosum*), and Russian thistle (*Salsola kali tragus*). The State laws relating to the destruction of Canada thistle and dagger cockle bur are given, and in addition to the ones enumerated above the author suggests that the laws be modified to include French pink (*Centaurea cyanus*), dog fennel (*Anthemis cotula*), tarweed (*Madia* spp.), white mustard (*Brassica campestris*), oxeye daisy (*Chrysanthemum leucanthemum*), and moth mullein (*Verbascum blattaria*).

Directions are given for the destruction of weeds in general, with specific directions for the 5 species particularly mentioned in the bulletin.

Germination of black walnuts and acorns, G. B. SUDWORTH (*Garden and Forest, 8 (1895), pp. 105, 106*).—The author accounts for the prolonged vitality of seeds deeply planted as due to the probably accidental but proper adjustment of moisture conditions.

The vitality of seed, A. PETER (*Nachrichten Kl. Ges. wissensch. Göttingen; abs. in Nature, 51 (1895), Feb. 28, p. 422*).—The author gives the results of a second series of cultural experiments with dormant seeds taken from various depths in the soil of woodlands or forest. "The forest in question was the site of villages and cultivation that disappeared several centuries ago; and some of the samples were taken from a dense forest, 100 to 150 years old, under the shade of which there has been no surface vegetation for years. The principal point to investigate was the probable existence of seeds of cornfield weeds still possessing the power of germinating and developing into reproductive plants. The author succeeded in raising a large number of plants belonging to about 50 species, including some of the weeds of cultivation; and he believes he has good grounds for supposing that many pasture plants and cornfield weeds retain their vitality for more than a half century, under the conditions he describes."

On the seeds of Moabi, H. LECOMTE and A. HÉBERT (*Compt. Rend., 120 (1895), No. 7, pp. 374–377*).

On the seeds of the Coula of the French Congo, H. LECOMTE and A. HÉBERT (*Compt. Rend., 120 (1895), No. 4, pp. 200–202*).

Methods of planting and destroying Bermuda grass, C. L. NEWMAN (*Arkansas Sta. Rept. 1894, pp. 103–108*).—A reprint from Bulletin 28 of the station (E. S. R., 6, p. 430).

A method of destroying dodder, A. SERVAIS (*Ingén. Agr. Gembloux, 5 (1895), No. 8, pp. 354, 355*).—The plants on the spots where dodder is present are carefully removed and burned, the spot is worked with a hoe or rake, and orchard grass or some other quick-growing species is planted on the infested spot. The author states that dodder thus treated may be entirely eradicated within 2 years.

Troublesome grasses of southern New Jersey, M. TREAT (*Garden and Forest, 8 (1895), pp. 103, 104*).—Notes are given on *Elusine indica, E. ægyptiaca*, Bermuda grass, and coco or nut grass.

DISEASES OF PLANTS.

Fungus diseases of plants, B. D. HALSTED (*New Jersey Stas. Rpt. 1893, pp. 326–436, figs. 63*).

Synopsis.—Notes are given on fungi on weeds, strawberry diseases, club root of cabbage and its allies, soil rot of sweet potatoes, on the identity of the anthracnose of watermelon and bean, fungus diseases of the muskmelon, some fungus diseases of the pea, a fatal disease to truck crops, field observations upon fruit decays, decays of mature apples, blight of ornamental spurge, fungus diseases of cultivated sedums, hollyhock fungus diseases, some carnation fungus diseases, mint rust on balm, fungus diseases of ornamental bulbous plants, anthracnose of rose, ivy blight, palm diseases, blights of dracæna, orchid diseases, blight of ornamental ferns, bacteria in some of their relations to crop growing, leaf blight of calceolaria, dropsical pelargoniums, and notes on a new *Exobasidium.*

Fungi on weeds (pp. 326, 327).—Notes are given on several fungi that serve to keep some of our worst weeds in check. The species of fungi mentioned are *Cystopus candidus* on the shepherd's purse and some other cruciferous plants, *C. portulacæ* on the common purslane, and *Puccinia suaveolens* on the Canada thistle. A report is given of the last-named fungus having nearly exterminated an acre of the thistle, scarcely a plant maturing any seed.

Diseases of the strawberry (pp. 327–332).—The more important fungus diseases of the strawberry as enumerated are: Leaf spot (*Sphærella fragariæ*), leaf blight (*Phyllosticta fragaricola*), leaf spot (*Septoria aciculosa*), leaf spot (*Ascochyta fragariæ*), anthracnose (*Glæosporium fragariæ*), leaf blight (*Ramularia modesta*), and mildew (*Peronospora fragariæ*). Of these the leaf spot (*Sphærella fragariæ*) is perhaps the most destructive. The author reviews the more important contributions on this disease since 1887, when there was given a comprehensive bibliography.[1] Another of the leaf spots (*Ascochyta fragariæ*) may easily be mistaken for this disease. A new strawberry leaf blight has been under investigation by the author since 1892. It was first discovered near Syracuse, New York, and it seems to be far from rare, though often obscured by the presence of other fungi. The disease is caused by a fungus apparently of the genus *Aposphæria*. This fungus appears to prefer the upper surface of the leaf, but develops its pycnidia on both sides of the leaf. The affected portions lose their characteristic green and soon become brown. The pycnidia first appear as minute

[1] U. S. Dept. Agr. Rpt. 1887, p. 340.

elevations of the same color as the leaf, but as the spores mature they become amber colored and rise prominently from the leaf. Inoculations under a bell jar gave within 10 days well-developed pycnidia on healthy leaves. As a rule it is only the old leaves that are affected and these should be burned. Bordeaux mixture may prove effective against this blight.

Club root of cabbage and its allies (pp. 332–345).—This is a reprint of Bulletin 98 of the station (E. S. R., 5, p. 685).

Soil rot of sweet potatoes (pp. 345, 346).—A report is given of some field experiments conducted with the view of checking the soil rot of sweet potatoes. Series of rows of plants growing in infested soil were treated as follows:

"(1) On May 13, 2 rows while still open and before manuring, were sprayed thoroughly with the Bordeaux mixture.

"(2) On May 13, 2 rows sprayed as in 1 after the manure had been placed.

"(3) Two rows left untreated.

"(4) On May 13, 2 rows sprayed after they were made up and before setting the plants.

"(5) On May 20, 2 rows with the plants sprayed directly after setting.

"(6) On August 10, 2 rows sprayed after the plants had run vines 18 to 20 in. long."

The results obtained showed "that spraying the rows before the addition of manure is the better way of treating the ground for the prevention of the soil rot of the sweet potato." There appears, from the tabulated results given, a gradual increase in the amount of soil rot present from the first series to the last.

Identity of the anthracnose of the bean and watermelon (pp. 347–352).—The author reports having inoculated citrons on opposite sides of a line with spores from the bean and watermelon. Both inoculations grew rapidly and no differences could be detected, proving the identity of the two diseases. The author reviews the synonymy of the fungus and concludes the name should be *Colletotrichum lagenarium*.

Fungus diseases of the muskmelon (pp. 352–356).—Mention is made of three of the more important diseases of the muskmelon. The first is a downy mildew (*Plasmopara cubensis*), similar to the downy mildew of the grape and amenable to the same treatment. The second is of a bacterial nature. Parts of the plant, as the stem, petioles, or leaf blades, when attacked have a peculiar watery appearance. The author thinks it probable that the germs of this disease may be carried over from year to year in the soil, and probably several crops may be affected by the same disease. Spraying is thought to check the disease. The third trouble is a leaf spot due to a species of *Phyllosticta*. It is confined to the leaves and younger parts of the vine, and it seems very probable that it could be controlled by spraying with any of the more common fungicides.

Some fungus diseases of the pea (pp. 357–362).—Several fungus enemies of the pea are described, the more important being pea mildew (*Erysiphe martii*), pea rust (*Uromyces appendiculatus*), pea blights (*Ascochyta pisi*

and *Septoria pisi*), black mold of pea (*Pleospora pisi*), damping off (probably *Pythium debaryanum*), a bacterial disease, and a disease attacking the seed, producing dark olive patches on the seed coat a few days after planting. These diseases may occur singly or more commonly associated with some of the others. The nature of their attack on the host is described, and the use of fungicides and selection of sound seed recommended as preventive treatment.

A fatal disease to truck crops (pp. 362–366).—Specimens of diseased tomato, eggplant, and other plants were sent the author from the Florida Experiment Station, and the disease was recognized as similar to one on lupines in Louisiana, in which a *Penicillium* developed abundantly when placed in a moist chamber. Cultures made from the Florida material developed sclerotia abundantly in a short time. Cultures were made on the stems of corn, squash, cucumber, and several weeds, upon all of which the fungus grew vigorously. Open-air cultures were not so successful, and on some plants the fungus was made to grow only by exercising great care, and it is thought that while the disease may be very destructive in Florida it will not prove serious in the latitude of New Jersey. The study of this disease is still in progress.

A field observation upon fruit decays (pp. 366, 367).—In Bulletin 91 of the station (E. S. R., 4, p. 657) the author reported on a decay of quinces due to *Sphæropsis malorum* and claimed that the source of contamination was an apple tree near by. A visit was made in July, 1893, to the orchard, and while there was no decay manifest on the quinces and pears, a grafted branch of the suspected apple tree was loaded with fruit, a large per cent of which was decayed. The fruit on the remaining branches of the tree was unaffected. The obvious remedy in this case was removing the graft of the early variety of fruit (Red Astrachan).

Decays of mature apples (pp. 367–377).—This is a reprint of a popular article[1] in which are described specking of apples, apple scab, mold, blotch, bitter rot, and black rot.

Blight of ornamental spurge (pp. 377–379).—An anthracnose of euphorbias, due to *Glœosporium euphorbiæ*, is described.

Fungus diseases of cultivated sedums (pp. 379–381).—Two diseases of sedums are described, an anthracnose due to *Septoria sedii*, and a disease due to *Vermicularia telephii*. The affected portions should be collected and burned to prevent the spreading of the diseases.

Hollyhock diseases (pp. 381–383).—Descriptions are given of a hollyhock rust (*Puccinia malvacearum*), a leaf spot (*Cercospora althæina*), and a leaf blight (*Phyllosticta althæina*). All sorts of hollyhocks are subject to these diseases. The author recommends that seed should be saved only from plants free from disease, that all young plants known to be affected should be rejected, and that old plants be sprayed with Bordeaux mixture at least once a week during the growing season.

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[1] Pop. Sci. Monthly, 1893, May.

Some fungus diseases of carnations (pp. 384–391).—A popular paper read before the American Carnation Society, January, 1893, describing carnation leaf spot (*Septoria dianthi*), anthracnose (*Volutella* sp.), leaf mold (*Heterosporium echinulatum*), and a bacterial disease. Remedies are suggested for carnation diseases, the most successful ones being sprays of potassium sulphid solution, Bordeaux mixture, and ammoniacal copper carbonate.

Mint rust on cultivated balm (pp. 391, 392).—The mint rust (*Puccinia menthæ*) is reported on the cultivated balm (*Melissa officinalis*). The form of rust present is the one having echinulate teleutospores and is known as form *americana*.

Fungus diseases of ornamental bulbous plants (pp. 392–396).—Diseases of lilies, hyacinths, tulips, narcissus, gladiolus, and crocus are described. The rejection of all diseased bulbs is advised as a precautionary measure.

Diseases of cyclamens (pp. 396–399).—Diseases due to *Phoma cyclamenæ*, *Botrytis vulgaris*, *Colletotrichum cyclamenæ*, and a bacterial disease are described.

Diseases of callas (pp. 399–401).—A bacterial disease, one due to *Phyllosticta richardiæ*, a disease due to *Cercospora richardiæcola*, and another due to *Pestalozzia richardiæ* are mentioned.

Rose anthracnose (pp. 401–405).—In the Annual Report of the station for 1892, p. 280 (E. S. R., 5, p. 399), mention was made of several destructive diseases of roses, among them an anthracnose due to *Glœosporium rosæ*, which causes the defoliation of the canes. Further investigations of this disease show that the whole plant is infested by the fungus, which saps its vitality to such a degree that those leaves showing no trace of disease are unable to perform their usual functions. The appearance and habit of growth of this fungus are similar to the raspberry anthracnose (*G. venetum*), and the author suggests their probable identity. Young plants or young shoots are most susceptible to the disease. Roses that have a sickly colored foliage, with the leaves falling prematurely, especially from the tips of the canes, may be suspected of being attacked by the anthracnose, and the pink blotches may be seen by the aid of a hand lens on the leaves and stems. All affected canes should be cut, and, together with the fallen leaves, gathered and burned. Sound plants may be protected by frequently spraying them with Bordeaux mixture or ammoniacal copper carbonate.

A blight of variegated ivy (pp. 405–407).—A blight of the variegated forms of the English ivy is reported due to *Vermicularia trichella*. All variegated plants are especially susceptible to fungus diseases, as the etiolated portions are less able to resist the entrance of the spores. All diseased leaves of such plants should be removed and the remaining ones protected by sprays of copper compounds.

Palm diseases (pp. 407–411).—Several diseases of palms, especially Kentias, are figured and described. All diseased leaves or parts of

leaves, which may be recognized by the dead or discolored spots, should be removed and the remaining foliage sprayed at least once a week with Bordeaux mixture. A leaf blight of caryotas is also described and the same treatment recommended.

Blights of dracænas (pp. 412–414).—A blight, due to *Phyllosticta maculicola*, causing small brown angular spots in the leaves, surrounded by yellowish areas, is described. Another blight more destructive to the thick leaved dracænas is caused by *Vermicularia concentrica*. A third disease, a leaf tip blight of *Dracæna fragrans*, caused by *Glæosporium* sp., is illustrated and described. The author thinks these diseases could be prevented to a great degree by the use of any of the standard fungicides.

Orchid diseases (pp. 414–419).—Leaf diseases of *Sorbralia macrantha* and *Bletia volutella*, and petal blights are described. Care in not propagating from diseased plants and use of fungicides are advised as preventive treatment.

Tip blight of ornamental ferns (pp. 419–421).—Fern blights are described and Bordeaux mixture as a preventive treatment advised.

Bacteria in some of their relations to crop growing (pp. 422–430).—A reprint is given of a semipopular paper on bacteria read before the New Jersey Horticultural Society.

Bacterial leaf blight of calceolarias (pp. 430, 431).—A disease, due to *Micrococcus* sp., is described as causing brownish patches on the lower leaves.

Dropsical pelargoniums (pp. 432, 433).—Numerous instances are reported of pelargoniums being spotted, but no fungus could be found. The author thinks it probable that the plants were affected by the same cause, resulting in what has been called œdema of tomato.[1] The remedy recommended is a cooler, dry soil, with increased light wherever possible.

Notes on a new Exobasidium (pp. 434–436).—Notes are given on *Exobasidium peckii*, a fungus almost entirely confined to the inflorescence of *Andromeda mariana*, its attack resulting in abnormally developed flowers.

Report of the mycologist, F. D. CHESTER (*Delaware Sta. Rpt. 1893, pp. 103–131, figs. 2*).

Synopsis.—A report is given on the treatment of peach rot and blight; observations on root rot of crimson clover, diseased cowpeas, and anthracnose of tomato; and a report of bacteriological work in various lines, principally in the preparation of attenuated anthrax virus.

Treatment of plant diseases (pp. 103–109).—Experiments were conducted in 2 orchards for the prevention of peach rot and blight. The treatment consisted in (1) winter treatment, the removal of all mummy fruits and washing the trees with a copper sulphate solution; (2) spraying twice before the buds opened; (3) spraying with Paris green for

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[1] New York Cornell Sta. Bul. 53 (E. S. R., 5, p. 55).

curculio; and (4) spraying when the fruit began to show color to prevent attacks of the rot. In the first orchard the fungicides used as sprays were ammoniacal copper carbonate and suspended copper carbonate with glue. As a result of the winter treatment it was found that 26 per cent blighted blossoms were on the unsprayed trees, as compared with 12 per cent on those given treatment and 17 per cent on those given the early spraying but no winter treatment. Owing to the fruit not having been gathered according to directions, the results of the other treatments were lost.

In the second orchard the same treatments were tested with 3 additional fungicides, viz, copper and ammonium carbonate, copper acetate, and copper sulphate and calcium chlorid solutions. The results obtained indicate encouraging benefits from spraying, and the question of whether winter treatment and early spraying is not sufficient is to be the subject of further experiment. The use of Paris green was attended with a greater total yield over their checks, amounting to about 3 times the yield where no treatment was given. There was a decreased amount of rot present in those trees having been treated for that disease.

Observations on plant diseases (pp. 109–115).—The author made cultures of the crimson clover root rot, *Sclerotinia trifoliorum*, previously published as *S. trifolium*,[1] and found it would grow readily on indifferent media. This shows its power to live as a saprophyte as well as parasitically on its host. Any cultivation that tends to stir the soil will tend to eradicate the fungus.

A lot of cowpea seed was sown, and the developing plants were so badly diseased as to require a replanting. The second lot of seed was examined and 9.5 per cent found to be affected by *Colletotrichum lindemuthianum*. The presence of the disease can be recognized by the spotted appearance of the seed, and all such should be rejected.

Notes are given on the ripe rot or anthracnose of tomato. In the Annual Report of the station for 1891, p. 60 (E. S. R., 5, p. 59), this disease was described as due to *C. lycopersici*, n. sp., but the author has since decided it as identical with *C. phomoides*, the name by which the fungus should be known. The author made numerous inoculations with the spores, and found that they would as readily grow on the pepper, grape, and apple as on the tomato, a fact which he thinks points toward the probable identity of the ripe rots of these fruits.

Bacteriological work (pp. 115–131).—The author gives in detail the methods followed in preparing an attenuated anthrax virus for use in the protection of cows against anthrax. The method employed was that of attenuation by heat, keeping the cultures at a temperature of 42 to 43° C. for a time, the different lots being tested until the required attenuation is secured. Examinations were made by the author of milk and a supposed case of anthrax in man without finding the specific bacilli present, while they were found in a case of anthrax in a horse.

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[1] Delaware Sta. Rpt. 1890, p. 84 (E. S. R., 3, p. 689).

A microscopical examination of 4 lots of wheat bran was made to ascertain the presence of cockle-seed meal. In none of the samples was there any important admixture. The presence of cockle may be readily recognized when at all abundant by the characteristic saponin bodies.

The author made a study of some of the mold fungi to test the common belief that cerebro-spinal meningitis is due in some way to these fungi. Jars of bread paste were exposed in a stable where several horses had died with the above disease. The species of molds collected were: *Aspergillus nigricans*, *A. fumigatus*, *Rhizopus nigricans*, and *Penicillium glaucum*. The only fungus of interest was the *Aspergillus fumigatus*, and from this cultures were made on oats. Nothing positive is shown as to the ability of these molds to produce the disease in question. However, a rabbit inoculated with 0.5 cc. water containing spores of *A. fumigatus* died in 5 days. Cultures made from the viscera of the rabbit did not develop any of the mold in either agar tubes, Petrie plates, or bread-paste jars.

The southern tomato blight (*Mississippi Sta. Rpt. 1893, pp. 53–61, fig. 1*).—A report is given of 3 years' experiments, conducted by F. S. Earle at the Ocean Springs substation, for the prevention of the tomato blight, reported in Bulletin 19 of the station (E. S. R., 3, p. 702). The experiments consisted in soil treatments in the field and bed and spraying the plants with well-known fungicides. Based on 1 year's experience, the author thinks that whether the blights of tomatoes, potatoes, and watermelons are identical or not they are not easily communicated from one crop to another under the ordinary field conditions.

The author presents the following tentative conclusions:

"(1) In preparing compost for the seed bed and cold frame, use a liberal amount of lime, kainit, ashes, or other potash salt. This will give good, stiff-stemmed, stocky plants, which are better able to resist blight.

"(2) A few days before sowing the seed sprinkle the bed thoroughly with strong Bordeaux mixture and rake it in.

"(3) After the plants are set in the field add Paris green to the Bordeaux mixture and continue to spray at intervals of 10 days or 2 weeks until the fruit is half grown. Care must be exercised in spraying after the fruit is set, as it is more easily injured than is the foliage.

"(4) Never plant tomatoes on land where they grew the previous year, and at least 2 years' rest is much safer.

"(5) While this station does not recommend the practice of following either melons or potatoes with tomatoes, it records the fact that it can often be done with safety."

A new disease of the olive tree, A. P. HAYNE (*California Sta. Rpt. 1893 and 1894, pp. 297, 298*).—The author reports the presence in various parts of the State of a new leaf disease of olives, which he has determined as probably due to *Cycloconium oleaginum*, a fungus which is rather common in southern Europe. He quotes G. Boyer, of the École Nationale d'Agriculture, Montpellier, France, who has made an exhaustive study of the disease. Both surfaces of the leaf are attacked, but more commonly the upper, where it forms circular spots, black,

gray, or brownish in color, the center usually being of a different color from the surrounding portions of the spots. The spots vary from 6 to 15 mm. or more in diameter and are irregularly distributed over the leaf, and may sometimes be found on the peduncle and fruit. The fungus may appear any time of the year, but its most serious attack is usually late in the summer or autumn. The black color is due to the presence of the abundant dark-colored spores, and as these become scattered the color becomes lighter.

In California the only variety on which the disease has been observed is the Mission. Its attack is so insignificant that at least for the present no treatment is required.

Experiments in winter spraying of apples and pears, C. W. WOODWORTH (*California Sta. Rpt. 1893 and 1894, pp. 441–462*).—Notes and extensive tables on experiments in spraying apple and pear trees for two seasons against the oyster-shell scale, greedy scale, and woolly aphis, conducted in the station orchard at Berkeley. A plat is given showing the arrangement of the trees treated. Various insecticides and fungicides were used, both alone and in combination. The results, as indicated by the elaborate detail of the several tables, seem to show but little value from the treatment. Formulas are given for the preparation of various insecticides and fungicides and the indications for their use are mentioned.

Peach yellows experiments, M. H. BECKWITH (*Delaware Sta. Rpt. 1893, pp. 152, 153*).—The author reports experiments with seedling peach trees and with trees brought from a region where the yellows is not known, in which it is shown that such trees are no more capable of resisting the disease than others.

A disease of mulberries, A. PRUNET (*Compt. Rend., 120 (1895), No. 4, pp. 222–225*).—The author claims that there is great confusion in the diseases of the mulberry, due to their varying manifestations. He thinks there is a disease of the mulberry similar to that of the grape, which he has called chytridiose, and that it is due to a species of *Cladochytrium*, to which he has given the name *C. mori*. It differs from *C. viticolum*[1] in its smaller zoösporangia, cystes, and zoöspores. Its attack on the mulberry is very similar to that of the related species on the grape. The treatment recommended is the same in each case, applications of solutions of iron sulphate.

The black rot and its practical treatment, G. LAVERGNE and E. MARRE (*Le Black rot et son traitement pratique. Bordeaux: Féré, 1895*).—The authors have prepared a condensed manual based on their observations made in 1894 during an official examination of the black rot and its practical treatment.

Their conclusions are as follows:

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[1] Compt. Rend., 119 (1894), No. 19, pp. 808–811 (E. S. R., 6, p. 642).

"(1) After the grapes are gathered, collect all dried grapes and those which have fallen from the bunches, together with all the leaves that are strewn on the ground, and burn them.

"(2) Prune as closely as possible, eliminating all the young sprouts. Collect and burn the cuttings.

"(3) During the latter part of March wash the vines with an acid solution of copper sulphate to which there may be added iron sulphate if anthracnose be suspected, the formula recommended being copper sulphate 10 kg., iron sulphate 10 kg., sulphuric acid 1 kg., hot water 100 liters.

"(4) Upon the return of spring and when the young shoots are 6 to 10 cm. in length apply Bordeaux mixture, using 3 kg. copper sulphate to 3 kg. of lime. Apply whenever the atmospheric conditions will allow and repeat if washed off by rain.

"(5) Ten or 15 days later, depending on the size of the sprouts, give a second spraying.

"(6) Give a third, fourth, and if necessary a fifth spraying at intervals of 15 to 30 days, dependent on the atmospheric conditions.

"(7) Before the time for the appearance of oïdium, dust the vines with sulphur and dry copper sulphate or with copper sulphosteatite.

"(8) Supplement these treatments if practicable by collecting and burning the first leaves attacked by the black rot.

"(9) Wherever there has been no previous severe attack, the first 3 suggestions may be omitted, but by following out all the directions the vineyard will be free not only of black rot but of mildew as well."

A new treatment for grape mildew, L. SIPIÈRE (*Compt. Rend., 120 (1895), No. 4, pp. 220–222*).—The author reports the successful use of lysol as a remedy against grape mildew. He was led to make a trial of this material (1) on account of its well-known power as a germicide, (2) its ready solubility in water, (3) its harmlessness, and (4) its cheapness. It was used in solutions varying in strength from 0.001 to 0.01, the best results being obtained when used in the strength of 0.005, which is obtained by adding 5 gm. of lysol to every liter of water. When used in the strength recommended it proved as efficacious as Bordeaux mixture and was more economicalby 28 per cent. Three sprayings are necessary, and in France the proper time for their application is April 20 to 30, May 1 to 8, and June 1 to 8. When used in a strength of 0.004 it rids the leaves of all insects or larvæ that may be on them, and it may be used to rid the vine of all kinds of parasites.

The author thinks lysol will prove equally as effective against oïdium as it is shown to be against the mildew.

A laboratory of plant diseases, C. W. WOODWORTH (*California Sta. Rpt. 1893 and 1894, pp. 435, 436*).—A description is given of the laboratory of the University of California for the especial study of plant diseases.

Apple canker (*Gard. Chron., 17 (1895), ser. 3, p. 242*).—A controversial article in which the author thinks conditions of planting and natural hardiness have more to do with the disease than fungus attacks.

The canker of larch (*Oesterr. forst. Ztg., 13 (1895), No. 2, pp. 11, 12*).—A popular article on the diseased condition due to *Peziza wilckommii*.

Concerning Nectria ditissima, F. BANDISCH (*Centbl. Ges. Forstw. Wien, 21 (1895), No. 2, pp. 51–55*).—A popular article on the cause of canker in trees.

Root knots of fruit trees and vines, C. W. WOODWORTH (*California Sta. Rpt. 1893 and 1894, pp. 436–440, pl. 1*).—This article is a revised and enlarged reprint from Bulletin 99 of the station (E. S. R., 4, p. 563).

Hexenbesens (*Oesterr. forst. Ztg., 13 (1895), No. 2, p. 13*).—A description of witches broom of a 90-year-old pine tree.

A vine disease of Chile, A. GIRARD (*Rev. Vit., 2d ser., 3 (1895), No. 64, pp. 233–236*).—It is attributed to *Margarodes vitium*.

The relationship of Cæoma nitens and Puccinia peckiana, G. P. CLINTON (*Bot. Gaz., 20 (1895), No. 3, pp. 116, 117*).—Notes are given on the identity of the two forms and a discussion of the proper nomenclature for the fungus.

New species of Ustilagineæ and Uredineæ, J. B. ELLIS and B. M. EVERHART (*Torrey Bul., 22 (1895), No. 2, pp. 57–61*).—Technical descriptions are given of 14 new species, divided as follows: *Ustilago*, 1; *Entyloma*, 1; *Uromyces*, 2; *Puccinia*, 9; and *Æcidium*, 1.

Plant diseases caused by cryptogamic parasites, K. FREIHERR v. TUBEUF (*Pflanzenkrankheiten, durch kryptogame Parasiten verursacht. Berlin: J. Springer, 1895, pp. 600, figs. 306*).

How to distinguish fungus diseases of carnations, B. D. HALSTED (*Florists' Exchange, 7 (1895), No. 14, pp. 293, 294*).—Paper read by the author before the American Carnation Society. Carnation rust, leaf spot, black spot, ring mold, and bacteriosis are described. Copper sulphate 1 to 1,000 solution has given good results against these diseases and does not have the lime which is often objectionable in Bordeaux mixture.

Effect of treating barley seed for smut, M. HOLLRUNG (*Fühling's landw. Ztg., 44 (1895), No. 2, pp. 49–53*).

Experiments in treating potato blight, A. SEMPOTOWSKI (*Deut. landw. Presse, 22 (1895), No. 6, p. 51*).—A brief report on the use of Bordeaux mixture and sulphate of iron and lime.

Spraying of apple trees, J. T. STINSON (*Arkansas Sta. Rpt. 1894, pp. 23–44, fig. 1*).—A reprint from Bulletin 26 of the station (E. S. R., 5, p. 1076), giving details of experiments conducted for the prevention of apple scab and bitter rot.

Lysol as a fungicide for vines, L. MANGIN (*Jour. Agr. Prat., 59 (1895), No. 7, pp. 245, 246*).

The preparation of ammoniacal copper carbonate solution, C. L. PENNY (*Delaware Sta. Rpt. 1893, pp. 172–183, figs. 2*).—A reprint from Bulletin 22 of the station (E. S. R., 5, p. 1077).

ENTOMOLOGY.

The San José scale in New Jersey (*New Jersey Stas. Bul. 106, pp. 24, figs. 5*).—This bulletin treats of the introduction and spread of *Aspidiotus perniciosus* in New Jersey, its life history, description, enemies, and treatment. The scale was introduced on Kelsey plum trees from California in 1886 or 1887 by two nurseries, and spread rapidly, attacking other fruits as well, especially pears. In 1889 or 1890 the first scaly stock was distributed from these nurseries to different parts of New Jersey and other States. In New Jersey the scale has not been found on the red shale soil which occupies the northern half of the State, although south of this it has been found in every county. As California fruit, pears in particular, are frequently infested by the scale, it is urged that great care be taken to avoid a further infection with the pest.

The scale is described in detail in the various stages of growth, and the life history given, the information being chiefly compiled.[1]

It was found that many deciduous fruit trees were attacked by the scale, though not all to the same extent. Currants, gooseberries, rosebushes, elms, and English walnuts were also found infested. Apples, pears, plums, and cherries are attacked in preference. Idaho and Louisiana pear trees suffer most, while Keiffer is least likely to be attacked.

The scale was found parasitized by the hymenopter *Aphelinus fuscipennis*, which attacks about 1 per cent of the scales. In addition, 2 species of ladybirds, *Chilocorus bivulnerus* and *Pentilia misella*, feed upon *Aspidiotus*.

It is recommended that every orchard that has been set out within the last 6 years should be thoroughly examined, and if the scales are found they should be brushed off, so far as possible, with a stiff brush. Following this the trees should be liberally pruned and the cuttings burned. The trees should then be washed or sprayed with whale-oil soapsuds, or with the following potash solution: Crystal potash lye, 1 lb.; fish oil, 3 pt.; soft water, 2 gal. To this water should be added to bring the amount up to 15 gal. The application of this insecticide should be made during a mild spell in the winter, and a month later the trees should be sprayed with strong kerosene emulsion. Spraying with diluted kerosene emulsion in the spring when the larvæ are crawling about is also recommended. The importance of carefully inspecting all nursery stock is insisted upon.

Some insects injurious to squash, melon, and cucumber vines, and the asparagus beetle (*New York State Sta. Bul. 75, pp. 409–427, figs. 3, pls. 4*).—This bulletin contains illustrated descriptive, life history, and remedial notes on the squash bug (*Anasa tristis*), squash-vine borer (*Mellitia ceto*), boreal ladybird (*Epilachne borealis*), melon louse (*Aphis cucumeris*), striped cucumber beetle (*Diabrotica vittata*), and asparagus beetle (*Crioceris asparagi*). The investigations were undertaken on Long Island and vicinity, where the insects seemed to be inflicting most damage.

The squash bug was unusually injurious the past season, and experiments were made with carbon bisulphid, pyrethrum powder, and kerosene emulsion for its destruction. Pyrethrum was found to be of no avail and the other insecticides of but little use. Cleaning the fields of rubbish and plowing in the fall is recommended, and in addition distributing bits of boards, chips, leaves, and the like underneath the vines, where the bugs will gather during the day and may be easily captured and killed. Picking the adult bugs from the vines in the early spring is also advised.

The squash-vine borer inflicted more damage than any other of the

[1] U. S. Dept. Agr., Div. of Ent. Circular 3 (E. S. R., 5, p. 1088).

insects noted. Cutting out the borers as soon as the vines begin to show signs of injury and covering the bases of the vines with earth as far as the third or fourth joint is suggested, and also capturing and killing the moths which may be found sluggishly sitting on the leaves in the evening and early morning. Spraying with arsenites is recommended for the boreal ladybird. Kerosene emulsion or whale-oil soapsuds is advised against the melon louse, and picking and destroying the affected leaves. Against the striped cucumber beetle it is suggested that the hills be protected by covering them with screens or nettings of some kind until the vines have acquired a strong growth, and spraying with the arsenites, or dusting on tobacco dust, air-slacked lime, or a mixture of arsenites and plaster after the beetles have begun their attacks.

Against the asparagus beetle applying lime to the affected beds is recommended, and also cutting and burning the old stalks each fall and the young seedlings in the spring. It is also suggested that chickens be allowed to run among the beds.

Report on a so-called disease affecting the orange orchards of Wide Bay, and on insect pests prevalent therein (*Queensland Dept. Agr. Bul. 4, 2d ser., pp. 17*).—This deals with investigations on an affection of oranges called the "Maori orange," in which the fruit was covered to a greater or less extent with a brown stain, frequently obscuring the natural hue of the entire surface. The oranges were usually exceptionally sweet and juicy, but sometimes were black, and in this event the flesh was soft, discolored, and sour. The condition was found to be produced by the mite *Phytoptus oleivorus*, which fed upon the rind of the orange, puncturing the oil cells, from which the oil exuded and was oxidized by the atmosphere, thus producing a resinous dark stain. Treatment by means of a sulphur, soap, and water wash, or a spray of 2 oz. of potassium sulphid dissolved in 2 gal. of soapsuds is recommended. This insecticide should be applied in the spring before the growth commences, again when the fruit is the size of a marble, and later when it is about two thirds grown.

Descriptive, life history, and remedial notes are given on the white scale (*Chionaspis citri*), red scale (*Aspidiotus coccineus*), black scale (*A. ficus*), long mussel scale (*Mytilaspis gloveri*), and 5 species of brown scale (*Lecanidæ*). More persistent effort by fruit growers against injurious insects is urged.

Report of the entomologist, M. H. BECKWITH (*Delaware Sta. Rpt. 1893, pp. 154–171, figs. 7*).—This comprises a reprint of Bulletin 21 of the station (E. S. R., 5, p. 410) and some additional matter. A report is made of experiments with arsenites on several private farms to prevent the depredations of the curculio, the trees being sprayed with London purple, and the resulting fruit being almost entirely free from insect injuries. In another private orchard an experiment was conducted on 180 Abundance plum trees to determine the relative

value of jarring and of spraying the trees to protect the fruit from the curculio. One half of the trees were jarred, this treatment being given 15 times, beginning on May 15 and continuing for 3 weeks. The other half of the orchard was given 3 sprayings with a mixture of Paris green and lime in water. Three times as much foliage and fruit dropped from the sprayed trees as from those that were jarred, but the opinion is held that spraying with arsenites is the most economical method of treatment. Two apricot trees were sprayed 3 times with Paris green to protect against the curculio, with beneficial results, although the fruit was severely injured by a fungus which attacked it when nearly ripe.

Descriptive, life history, and remedial notes are given on the elm-leaf beetle (*Galeruca xanthomelæna*), strawberry weevil (*Anthonomus signatus*), wheat-head army worm (*Leucania albilinea*), and strawberry-root aphis (*Aphis forbesi*), which proved destructive in the State. The strawberry-root aphis was especially prevalent and injurious in the neighborhood of Felton, but yielded to treatment with bisulphid of carbon, though the remedy is too expensive to be generally recommended.

Report of the entomologist, J. B. SMITH (*New Jersey Stas. Rpt. 1893, pp. 439–603, figs. 197*).

Synopsis.—This report contains a general review of the work accomplished during the year, brief remarks on special insect outbreaks, and more extensive notes upon the pear midge, pear-tree psylla, wheat-head army worm, strawberry weevil, corn-root webworms, pale-striped flea beetle, and chestnut weevils. The bulk of the report is taken up by a more or less popular paper on the chief beneficial insects.

General review (pp. 439–453).—Notes on the routine work of the office, with special remarks on several injurious insects, particularly the sweet-potato flea beetle, melon louse, onion maggot, wheat-head army worm, pale-striped flea beetle, strawberry weevil, pear midge, a new asparagus beetle, and some cranberry insects. The entomological inquiries and information that were published through the summer in the crop bulletins are quoted.

Pear midge (pp. 453–460).—Notes on the life history and devastations of *Diplosis pyrivora*, and experiments with treatment for it, which have been given in previous publications of the station.

Pear-tree psylla (pp. 460–465).—General life-history notes for *Psylla pyricola*. Scraping off the rough bark of the infested trees and washing the trunks and larger branches with a solution of whale-oil soap in the winter, and in the spring spraying the trees with kerosene emulsion is recommended.

Wheat-head army worm (pp. 465–469).—Notes on the unexpected appearance of *Leucania albilinea*, its life history, and remedies. The larvæ appeared early in July, causing considerable damage to ripening wheat. Later in the season the insects vanished, and are supposed to have returned to their normal food plants, the wild grasses. Plowing

infested fields to a depth of 6 in. in the fall and again early in the spring is advised for the destruction of the pupæ.

Strawberry weevil (pp. 470–473.)—Descriptive and life-history notes for *Anthonomus signatus*. Covering strawberry beds by means of newspapers or screens of linen or cloth until the plants are in full bloom is advised, with a view to protecting the flowers until fertilization is accomplished.

Corn-root webworm (pp. 473–478).—Descriptive and life-history notes on *Crambus vulvivagellus*, with accounts of injuries and suggestions for treatment. Fall plowing, with a top dressing of kainit in the spring is advised.

Pale-striped flea beetle (pp. 478–480).—Brief notes on *Systena blanda* and damage inflicted by it. Underspraying with Paris green or London purple and lime as soon as the beetles are noticed is advised, adjacent weeds being also sprayed.

Chestnut weevils (pp. 481–485).—Life history and remedial notes on *Balaninus proboscoideus* and *B. rectus*. Planting of such varieties of chestnut trees as are least attacked, and the destroying of infested nuts as soon as they drop, are recommended.

Beneficial insects (pp. 485–603).—This part of the report comprises general popular remarks on the benefit derived by the farmer from predaceous and parasitic insects, and descriptions of many of the more important species are given in greater or less detail.

Entomology, F. L. WASHBURN (*Oregon Sta. Bul. 33, pp. 16, figs. 2, pls. 2*).

Synopsis.—This bulletin gives descriptive, life-history, and remedial notes on tent caterpillars, the grain plant louse, pear-leaf blister, and clover mite, with directions for making and using Koebele's resin wash.

Tent caterpillars (pp. 1–5).—The larvæ of 3 species of tent caterpillars (*Clisiocampa erosa*, *C. pluvialis*, and *C. constricta*) are described and remedies advised. The forms were abundant in the Willamette Valley during the season, the two first named species feeding upon various orchard trees, while *C. constricta* confined its devastations to oaks, particularly *Quercus garryana*. *C. pluvialis* was much less common than the two other species. The life history is briefly described and popular descriptions of the larvæ of each species are given. Brewer's blackbirds were found to eat the pupæ, but the hairy caterpillars were little molested by birds. Tachina and chalcid parasites were found to attack the larvæ, and some fungus diseases were also destructive, chiefly to *C. constricta*. Spraying with the arsenites is advised, but more particularly it is urged that the egg masses be gathered from the twigs of the fruit trees in autumn and winter and burned. An illustration on the cover of the bulletin is engraved from a photograph of the larvæ of the 3 species.

The grain plant louse (pp. 6–9).—*Siphonophora avenæ* was quite abundant in the wheat-growing districts, attacking also oats, rye, and mesquite grass. Its history and description are given. Burning stubble,

weeds, etc., immediately after harvest, and then cultivating the land and allowing no grass or grain crop in the field the following year, is advised. It is recommended that badly infested wheat and oats be cut while green and used for hay. A lady beetle (*Hippodamia convergens*), syrphus flies, and several hymenopterous parasites were found to reduce greatly the numbers of the lice. An illustration from a micro-photograph is given showing an *Aphidius* parasite in the act of emerging from a dead grain aphis.

The pear-leaf blister (pp. 9–12).—Brief notes on the appearance and life history of *Phytoptus pyri* and the injury caused by it to the foliage of fruit trees. It has been found to be quite common in Oregon, and illustrations are given showing the damage done to leaves and an enlarged figure of the insect. Pruning and burning the infested branches and spraying with kerosene emulsion in the autumn when the mites are migrating are recommended.

The clover mite (pp. 12, 13).—Notes on *Bryobia pratensis*, which is found to be quite prevalent in Oregon, where it infests several kinds of fruit trees in addition to clover and grasses. It is recommended that infested fruit trees be sprayed with kerosene emulsion to which a little sulphur has been added.

Koebele's resin wash (pp. 13–15).—Notes on the preparing of a resin wash, 4 lbs. of resin, 3 lbs. of carbonate of soda, and 1 gal. of water being boiled together until the resin is dissolved, and then 4 gal. of warm water added. One part of this wash to 6 parts of water is recommended for the woolly aphis, and 1 part to 10 or 12 parts of water for other plant lice and the mealy bug. Experiments were made on plum trees infested with hop lice by spraying them with different strengths of the wash. One part of the wash to 15 parts of water destroyed the lice, but did not injure the larvæ of the syrphus flies or lady beetles that were preying upon the lice, and this strength is then recommended for use against these aphides.

Synopsis of the Dipterous genus Phora, D. W. COQUILLETT (*Canadian Ent., 27 (1895), No. 4, pp. 103–107*).

Preliminary studies in Siphonoptera, II, C. F. BAKER (*Canadian Ent., 27 (1895), No. 3, pp. 63–67*).—This part of the paper treats of the family *Pulicidæ*.

The biology of the Lachninæ in the valley of the Vistula, A. MORDWILKS (*Zool. Anz., 18 (1895), No. 46, pp. 74–85*).

Oviposition in Cicada hieroglyphica, J. B. SMITH (*Ent. News, 6 (1895), No. 3, pp. 84, 85*).—Brief note on this species depositing its eggs in the soft rotten wood of a cedar tree.

Successful introduction of humble-bees into New South Wales, A. S. OLIFF (*Ent. Monthly Mag., 2d ser., 6 (1895), No. 63, p. 67*).—An abstract from a letter on the subject.

What insects deserve the protection of foresters, farmers, and gardeners? L. TASCHENBERG (*Welche Thiere aus der Insectenwelt sind dem Schütze der Forstleute, Landwirte, und Gärtner sowie der allgemeinen Berücksichtigung zu empfehlen und warum? Friedländer & S., 1895, pp. 33. Reviewed in Wien. Ent. Ztg., 14 (1895), p. 47*).

A lac insect from Madagascar, A. TARGIONI-TOZETTI (*Bul. Soc. Ent. Ital., 26 (1895), No. 3 and 4, pp. 425–469*).—*Gascardia madagascarensis* is described as a new genus and species, and compared with other lac insects from India.

The bee-eating habit of Phymata erosa, W. METCALFE (*Biol. Rev. Ont., 1 (1893), No. 4, pp. 107–109*).—This insect is considered very injurious to bees, and lists are given of insects eaten by it and by *Reduvius raptatorius*.

Grain insects. R. L. BENNETT and G. B. IRBY (*Arkansas Sta. Rpt. 1894, pp. 126, 127*).—A reprint from Bulletin 29 of the station (E. S. R., 6, p. 538).

The normal habitat of Pediculoides tritici, R. MONIEZ (*Rev. Biol. Nord. France, 7 (1895), No. 4, pp. 148–152*).—Notes on this insect, which is usually found in the stems of cereals, although sometimes it is parasitic upon man.

The potato stalk borer, Trichobasis trinotata, J. B. SMITH (*Ent. News, 6 (1895), No. 4, pp. 120–122, figs. 3*).—Notes on its devastation in New Jersey.

Notes on the cacao beetle, A. B. CARR (*Trinidad Field Nat. Club, 4 (1894), No. 4, pp. 110–112*).—Notes on the habits and devastations of *Steirostoma depressum*.

A new Chilean vine-destroying insect, E. C. REED (*Ent. News, 6 (1895), No. 3, pp. 85, 86*).—An account of *Margarodes trilobitum*, which is described as new.

Italian scale insects affecting the orange, A. BERLESE (*Le Cocciniglie Italiane viventi sugli agrumi, pt. 11, Avellino, 1894, pp. 201, pls. 13; extracted from Riv. Pat. Veg., 3 (1894), Nos. 1–8*).—This part of this elaborate work deals with the genus *Lecanium*.

Spread of Otiorhynchus ovatus, H. F. WICKHAM (*Soc. Ent., 1894, Dec., reprinted in Amer. Nat., 29 (1895), No. 338, pp. 177–179*).

Note on the invasion of locusts of the genera Ephippiger and Barbitistes, J. AZAM (*Bul. Soc. Ent. France, 1895, Feb. 27, pp. XLVII–L*).—The wingless species *Ephippiger terrestris* and *Barbitistes berengueri*, hitherto considered as rare and predaceous, do considerable damage to crops in France.

The gypsy moth in Massachusetts, W. C. WRIGHT (*Garden and Forest, 8 (1895), No. 368, p. 108*).—Urging that owners of comparatively small tracts of land can easily keep the insect in check.

An exterminator for the parasol ant, J. H. HART (*Roy. Bot. Gard. Trinidad, Bul. Misc. Inform., 2 (1895), No. 1, pp. 3–5, fig. 1*).—Illustrated description of a machine for smoking out the nest of this injurious ant, *Œcodoma cephalotes*.

Petroleum against the pourridie and the white grub, L. RAVAZ (*Rev. Vit., 2d ser., 3 (1895), No. 64, pp. 250, 251*).—Account of experiments, with good results in both cases.

Kerosene emulsion, S. B. CARPENTER (*Proc. Ga. Hort. Soc. 1892, pp. 34, 35*).—A popular paper on this insecticide, giving formulas for making it and directions for its application. It is advised that fruit trees that have been weakened by insect attacks be fertilized with sulphates in addition to being sprayed with kerosene emulsion.

Enemies to plant life and remedies, G. SPETH (*Proc. Ga. Hort. Soc. 1892, pp. 64–67*).—General remarks on various injurious insects and plant diseases, with recommendations for spraying with various chemical substances.

Entomological work at the Mississippi Station (*Mississippi Sta. Rpt. 1893, pp. 46, 47*).—A brief report on the nature of the entomological work carried on at the station during the year, giving a short account of the scope and aim of the experiments and investigations, and the bulletins issued.

FOODS—ANIMAL PRODUCTION.

Investigation of food materials, M. E. JAFFA (*California Sta. Rpt. 1893 and 1894, pp. 214–217.*)—This includes analyses of alfalfa hay, wheat, flour, bran, and screenings. The average analyses of these materials produced in California are compared with the averages of Eastern analyses. The alfalfa hay agreed quite closely with the average analysis of the same grown in the East. A comparison of wheat and its products is given as follows:

Average composition of wheat grown in California and the East, and products from the same.

	Number of analyses.	Moisture.	Ash.	Crude protein.	Crude fiber.	Nitrogen-free extract.	Crude fat.	Fuel value per pound.
Whole wheat:		*Per ct.*	*Per ct.*	*Percent.*	*Per ct.*	*Percent.*	*Percent.*	*Calories.*
California grown, average	5	11.35	1.74	11.31	2.60	71.09	2.08	1,399
Eastern grown, average	310	10.05	1.80	11.90	1.80	71.90	2.10	1,419
Fine wheat flour:								
California, average	3	13.81	.47	7.90	....	76.40	1.39	1,627
Eastern, average	22	12.50	.50	11.00	....	74.90	1.10	1,645
Coarse wheat flour (graham):								
California	1	12.12	1.58	8.50	....	75.84	1.96	1,650
Eastern, average	3	13.10	1.80	11.70	....	71.70	1.70	1,625
Wheat bran:								
California, average	4	12.42	5.61	13.44	8.52	56.41	3.74	1,151
Eastern, average	88	11.90	5.80	15.40	9.00	53.90	4.00	1,152
Wheat screenings:								
California, average	2	11.16	2.94	10.06	5.48	67.63	2.72	1,123
Eastern, average	10	11.62	2.91	12.48	4.93	65.11	2.95	1,114

"From an inspection of the data given for California wheat, it will be seen that there is but little variation from the average obtained from 310 analyses of the same food material grown east of the Rocky Mountains. . . .

"The California flour is much poorer in nitrogenous compounds than the Eastern flour of the same quality.

"The same statement applies to graham flour.

"While the percentage of [phosphoric] acid in the ash of the different flours is about the same, amounting to almost one half the ash, when we refer it to the flour as 100, the coarse material shows 0.75 as against 0.23 for the fine flour. This is owing to the total ash in the former case being about three times that obtained for the latter. It must not be supposed that because the coarse or graham flour contains higher percentages of nitrogenous and mineral matter than does the fine flour it is therefore in proportion more nutritious. The increased amounts of these elements come from the bran, very little of which is digested by the human stomach."

"It will be noted that the bran made in California contains considerably less crude protein, or nitrogenous matter, than does the same by-product from the East, as shown in the averages, by the figures 13.44 and 15.40, respectively. The fat percentage is also slightly lower for the California food. . . .

"The wheat screenings of this State, like the bran, contain less of albuminoids."

Gluten feeds, their source, composition, and methods of use, E. B. VOORHEES (*New Jersey Stas. Bul. 105, pp. 24, fig. 1*).—By way of introduction an enlarged cut is given of a corn kernel showing the position of the skin or husk, gluten layer, starch layer, and germ. The skin, germ and starchy parts were separated from 100 gm. of kernels of new corn as nearly as possible, and analyzed with the following results:

Analyses of whole and separate parts of corn kernel.

	Amount secured from 100 parts of original corn.	Water.	Composition of the water-free material.							
			Crude fat.	Crude fiber.	Crude protein.	Crude ash.	Carbohydrates.	Nitrogen.	Phosphoric acid.	Potash.
	P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
Original corn	100.00	24.74	4.34	2.02	12.65	1.73	79.26	2.02	0.83	0.47
Skin	5.56	15.29	1.59	16.45	6.60	1.27	75.36	1.06	.23	.38
Germ	10.17	29.62	29.62	2.88	21.71	11.13	4 .79	3.48	6.16	2.91
Starchy and hard part	84.27	21.66	1.54	.65	12.23	.68	85.58	1.96	.35	.17

"The germ, although only about 10 per cent of the whole kernel, contains 65 per cent of the fat, 61½ per cent of the mineral matter, 71 per cent of the phosphoric acid, 60 per cent of the potash, and 16½ per cent of the nitrogen, or protein. The remaining portions are characterized, the skin by its content of fiber, 51 per cent of the whole, and the starchy part by its carbohydrates, of which it contains nearly 90 per cent of that in the whole grain."

A brief explanation is given of the process by which the starch is separated commercially and the various by-products obtained:

"The residue in this manufacture may consist either of one product, a mixture of the gluten, germ, and hulls, or of three, when the gluten, germ, and hulls are each separated. . . . The entire residue is in color brighter yellow than corn meal, and of a much more bulky character, owing to the presence of a larger proportion of bran; the trade name of this product is gluten feed. The gluten is distinguished by a higher content of both protein and fat, and a bright yellow color, and is called gluten meal. The germ is more bulky than the meals, shows a high content of crude fat, and is called germ meal or germ food. The hulls are very bulky, show a high content of crude fiber, and are usually sold as corn bran."

Samples of these various by-products from corn were obtained from dealers in the State and directly from manufacturers, and analyses of these are given in the bulletin. These are classified as follows: (1) Gluten feed, (2) gluten meal, (3) grano gluten feed, (4) corn oil meal and cake, and (5) corn germ meal and corn bran. The trade names of the materials analyzed were as follows: Chicago gluten feed, Peoria gluten feed, Buffalo gluten feed, dry gluten feed, Chicago maize feed, cream gluten meal, King gluten meal, Iowa golden gluten meal, gluten meal (flour), Hammond gluten meal, Chicago gluten meal, grano gluten feed, corn oil meal, corn oil cake, corn germ food, germ meal, corn bran, corn hulls, and analyses are also given of hominy chop and cerealine feed.

These materials as classified in the bulletin, with the possible exception of grano gluten feed, show very wide variations in composition. For instance, the gluten meals on an average contained somewhat more fat and about one half more protein than the gluten feeds, but the Chicago gluten meal "contains less than half as much fat and about 60 per cent more protein than the gluten feeds." The Chicago maize feed, which is classed with the gluten feeds, contains about one third less fat[1] than the other gluten feeds. The corn germ food contains three and a half times as much fat as the product from another factory sold under the name of germ meal, and the corn hulls have only one half as much fat as the corn bran. These variations in composition and the confusion in regard to names leads the author to suggest that—

"Unless some good reason exists from the manufacturers' standpoint for the separation of the various parts of the corn, general use would be promoted by making but one product, which should consist of the total residue. It would relieve the purchasers of the uncertainty as to composition, reduce the danger liable to result

[1] The oil is said to have been partially extracted from this material.—ED.

from the careless feeding of the more highly concentrated parts of the residue, and abolish the necessity of a study of comparative values as now manufactured."

Statements are made in regard to the palatability and feeding value of these different feeding stuffs and suggestions regarding their use in compounding rations.

The determination of the ash, phosphoric acid, and potash in the whole kernel and in the various by-products is given as follows:

Ash constituents in corn and its by-products.

	Ash.	Phosphoric acid	Potash.
	Per cent.	*Per cent.*	*Per cent.*
Corn	1.50	0.70	0.40
Buffalo gluten feed	.87	.34	.08
Gluten meal	1.29	.56	.07
Chicago gluten meal	.89	.35	.06
Corn oil meal	2.28	1.36	.14
Corn bran	.81	.24	.06

"With one exception the original corn contains more total ash, and more phosphoric acid, and in every case more potash than any of the products derived from it as feeds."

In conclusion remarks are made on the value of the fertilizing ingredients of different feeding stuffs, and a table is given showing the pounds of fertilizing ingredients in a ton of a number of different cereals and by-products.

Feeding experiments with horses (*New Jersey Stas. Rpt. 1893, pp. 179–187*).—This is a continuation of the experiments in feeding horses reported in Bulletin 92 of the station (E. S. R., 4, p. 742). Two teams of horses on the college farm were divided into 2 lots, 1 horse from each team being in each lot. Both lots received alike 8 lbs. of timothy hay and 6 lbs. of corn. In addition lot 1 received 6 lbs. of dried brewers' grains, while lot 2 received 5 lbs. of wheat bran and 1½ lbs. of new-process linseed meal per head daily. The grain for each lot was mixed and fed in 3 portions, morning, noon, and night. The corn was at first fed whole, but afterwards ground. The experiment lasted 6 months, from June 1 to December 1, and was preceded by a preliminary trial of 1 week. All of the animals performed similar work. The horses were weighed each week, and a record is given of the changes in weight, food eaten, and general condition.

"The weights of the animals remained remarkably uniform. The difference between highest and lowest did not exceed 75 lbs. in any case, the lowest recorded occurring in July, except for horse No. 3, whose final weight was the lowest. The average weight for the 6 months is practically identical in all cases with the average weight of the first month, though it is lower in all cases than the first weight recorded, and is uniform for both lots.

"The uniformity in the amount of the food consumed and in the weight of the animals, in connection with the work performed, indicates no material difference in the usefulness of the two rations used. Both were entirely satisfactory."

The cost of the rations is based on the following prices: Timothy hay, $18; wheat bran, $17.50; corn meal, $22; dried brewers' grains,

$17; and linseed meal, $29 per ton. At these prices the cost of the brewers' grain ration was 19.8 cts. per day for horse 1, and 18.9 cts. for horse 3; and the wheat-bran ration, 20.8 and 22.3 cts., respectively.

"It is observed that the cost of the daily rations used is much less than is ordinarily charged for feeding work horses. . . .

"That is, for the 6 hardest-working months of the year a farm horse of 1,000 lbs. live weight may be fed for $30.84, when dried brewers' grains furnish the bulk of the necessary protein, and for $33.49 when wheat bran and linseed meal are the chief sources of this nutrient; on the basis of actual cost of the rations only, the brewers'-grains ration is slightly more satisfactory, or 8.6 per cent cheaper than the wheat-bran ration. When the fertility value of the dried grains, wheat bran, and linseed meal is regarded as of importance, the differences in the rations are less marked."

Mention is made of a market gardener in the State who reports saving about 20 per cent on the cost of keeping horses by feeding a ration similar to that given to lot 1. Assuming that the cost of feeding the horses and mules of the State is 20 per cent higher than it need be, which is believed to be a conservative estimate, "the expense of feeding the horses of the State for the 6 working months would be reduced by $700,000 if more rational measures were adopted."

Fodders and feeds (*New Jersey Stas. Rpt. 1893, pp. 158–178*).—Analyses are given of green crimson clover, cowpea vines, corn stalks, corn fodder, shelled corn, sugar beets, corn cob, corn meal, gluten meal, gluten feed, brewers' grains, wheat bran, cotton-seed meal, linseed meal, rice polish, and Paine's stock feed; the market prices of a large number of commercial feeding stuffs from 1891 to 1894; an article on corn stalks and straw as hay substitutes, reprinted from Bulletin 96 of the station (E. S. R., 5, p. 499); and the average composition of a large number of feeding stuffs, largely compiled.

The relative values of winter and spring wheat bran, A. T. NEALE and C. L. PENNY (*Delaware Sta. Rpt. 1893, pp. 16–18, 191*).—Analyses of 4 samples of wheat bran from spring, winter, and local wheat, with a statement of the weight per double bushel, the selling price, and the calculated value according to the station's basis of valuation. In the latter respect the local product was below the others. The heavier bran was valued the highest.

Feeding stuffs, C. L. PENNY (*Delaware Sta. Rpt. 1893, pp. 191, 192*).—Analyses of crimson clover straw, crimson clover chaff, crimson clover seed, peavines (green), gluten feed, distillery corn feed, and wheat bran.

An easy method for detecting a common adulterant of ground pepper D. MARTELLI (*Staz. Sper. Agr. Ital., 28 (1895), No. 1, pp. 53–56*).

Fruit as an article of diet and as a medicinal agent, J. P. H. BROWN (*Proc. Ga. Hort. Soc. 1892, pp. 35–37*).—General and popular remarks on the healthfulness of a fruit diet, different fruits and vegetables being recommended for various minor disorders of the system.

The feeding of farm animals, E. W. ALLEN (*U. S. Dept. Agr., Farmer's Bul. 22, pp. 32*).—This is a popular bulletin on the principles of feeding; feeding standards; maximum, minimum, and average composition of the principal feeding stuffs; calculation of the digestible materials in a large number of common feeding stuffs; calculation of rations for cows, steers, pigs, etc.; the origin of by-products used as feeding stuffs; preparation of food; and wheat as a food for animals.

Stock feeding, G. L. TELLER (*Arkansas Sta. Rpt. 1894, pp. 137–170*).—A reprint of Bulletin 30 of the station (E. S. R., 6, p. 663).

Further notes on the use of peanut oil as a substitute for milk fat in calf feeding, M. PETERSEN (*Braunschw. landw. Ztg., 63 (1895), No. 3, p. 10*).

Feeding for milk (*Mississippi Sta. Rpt. 1893, pp. 30–32*).—Short accounts of work previously published in Bulletins 13 and 15 and reprinted in the Annual Reports of the station for 1890 and 1891 (E. S. R., 2, pp. 362, 658; 3, pp. 166, 875).

Salting cows (*Mississippi Sta. Rpt. 1893, p. 32*).—A reprint from the Annual Report of the station for 1888 (E. S. Bul. 2, pt. 1, p. 108).

Milking (*Mississippi Sta. Rpt. 1893, pp. 32, 33*).—A reprint from the Annual Report of the station for 1888 (E. S. Bul. 2, pt. 1, p. 108).

The preparation of food for swine, WERNER (*Braunschw. landw. Ztg., 63 (1895), No. 4, pp. 14, 15*).—Grinding and steaming grain, the preparation of potatoes and Jerusalem artichokes and roots, the effect of different foods on character of flesh and lard, and the amounts of different foods required to produce 1 kg. of increase in live weight are briefly discussed.

VETERINARY SCIENCE AND PRACTICE.

Cerebro spinal meningitis in horses, A. T. NEALE (*Delaware Sta. Rpt. 1893, pp. 23–39*).—The subjects treated are the prevalence, symptoms, *post-mortem* appearances, theories as to the causes, and experimental studies on the causes of this disease.

The following food stuffs were suspected of having caused the disease: Good corn silage, decayed corn silage, musty-blade fodder, musty-top fodder, musty oats, and wheat bran. All of these foods were fed to animals believed to be susceptible, but with negative results. German veterinarians believe that wheat cockle (*Agrostemma githago*) under certain conditions that are not well understood causes death in horses. Hens fed largely on ground cockle died, their symptoms being those of narcotic poisoning. But another flock of fowls ate perfectly dry cockle seed without visible injury; grain screenings containing a large proportion of cockle were fed to a colt with negative results. The results were also negative when screenings were first fermented and afterwards dried and ground.

To determine whether stinking smut of wheat (*Tilletia lævis*) had any connection with meningitis, wheat bran infested with this fungus was fed to a horse with negative results. The feeding of oats containing *Aspergillus fumigatus* also gave negative results.

Hydrophobia in farm stock, A. T. NEALE and P. GIBIER (*Delaware Sta. Rpt. 1893, pp. 48–59, fig. 1*).—Two outbreaks of hydrophobia in Delaware are noted. A general discussion of hydrophobia and an abstract of the German laws on the subject are given, as well as brief notes on a horse and dog successfully treated with vaccine after being bitten.

"A temperature of 70° C. (158° F.) will destroy the microbe [of hydrophobia] after a few minutes' exposure; desiccation destroys it in a few hours . . . and acids and disinfectants destroy it easily; but it resists putrefaction for a time and keeps its virulent properties for several weeks when it is kept cold. . . . The virus of hydrophobia can be put with impunity in contact with the skin or taken through the mouth without causing any disturbance. . . . The almost unique way of propagating the disease is by a bite. . . . It is not necessary to submit the stables or yards in which cattle affected with rabies have been confined to the same disinfection which would be required for anthrax or glanders. Washing with hot water contain-

ing a small quantity of sulphuric acid, followed by spontaneous desiccation, will be sufficient. . . . Cauterization, even when applied a few moments after the bite with the strongest acids, caustic, or cautery, is not sufficient to protect against the infection. . . . I would rather suggest that the wound be washed with a [1 per cent] solution of bichlorid of mercury, peroxid of hydrogen, or any strong disinfectant."

Investigations concerning bovine tuberculosis, D. E. SALMON (*U. S. Dept. Agr., Bureau of Animal Industry Bul. 7, pp. 178, pls. 6*).—This bulletin consists of articles on the following subjects:

Clinical and pathological notes on a herd of 60 cattle treated with tuberculin, F. L. Kilbourne, E. C. Schroeder, and T. Smith (pp. 7–74).—In a herd of 60 animals tested with tuberculin this method of diagnosis acted correctly, indicating the presence or absence of tuberculosis in 86⅔ per cent of the cases. Of 53 tuberculous animals, 47 were affected with tuberculosis of the organs situated in the chest. "Infection by way of the intestinal tracts was indicated in 14 cases by tuberculosis of a smaller or larger number of mesenteric glands."

Further experimental observations on the presence of tubercle bacilli in the milk of cows, E. C. Schroeder (pp. 75–87).—Of 19 specimens of milk obtained from the general milk supply of Washington one sample contained the bacillus of tuberculosis in sufficient numbers to produce the disease in 1 of the 2 guinea pigs injected with it.

Studies in bovine tuberculosis with special reference to prevention, T. Smith (pp. 88–128).—The author finds that the extent and rapidity of the disease of the lungs depends at least in part upon the number of tubercle bacilli inhaled either within short or long periods of time, and that tuberculosis of the lungs is not necessarily associated with any other recognizable lung affection as a preëxisting favoring condition.

Some practical suggestions for the suppression and prevention of tuberculosis, T. Smith (pp. 129–146).—The danger of infection from different sources is summarized by the author as follows:

"(1) Fully nine tenths of all diseased animals have been infected by inhaling the tubercle bacilli, dried and suspended in the air.

"(2) Fully one half of all diseased animals have been infected by taking tubercle bacilli into the body with the food. Frequently both food and air infection are recognizable in the same animal.

"(3) Animals are infected, though rarely, during copulation. In such cases the disease starts in the uterus and its lymph glands or in the sexual organs and corresponding lymph glands of the bull.

"(4) Perhaps from 1 to 2 per cent of all calves are born tuberculous."

The presence of tuberculosis in one herd is not believed to endanger other herds near by which do not mingle with the diseased herd in pasture or stable. In the absence of the tuberculin test the stockman is advised to remove from his herd and have destroyed—

"(1) All animals which show emaciation with coughing and any suspicious discharges from the nose.

"(2) Those animals with enlarged prominent glands about the head (in front of the eyes, under and behind the lower jaw), all enlarged glands in front of the shoulder, in the flanks and behind the udder.

"(3) Animals with suspected tuberculosis of uterus and udder."

Tuberculin and its use, A. E. de Schweinitz (pp. 159–178).—"The danger of injecting tuberculin into healthy animals in moderate quantity is slight. In healthy guinea pigs I have found that an injection of a dose 20 times as large as that required to produce a reaction in a diseased cow may kill, but does not always do so."

Examinations were made of samples of cow's milk (1) the day before injection, (2) the day after injection when the temperature was about at the maximum, and (3) a day or two after injection.

"In general the results show a decrease in total solids in the [milk of] tuberculous animals after the injection. In the healthy animals there is also a slight decrease in solids, but not as much as in the diseased animals.

"There is also a decided variation in the proportion of fat before and after injection of the tuberculin as well as albuminoids and sugar. The fat and sugar decrease, the albuminoids show a slight increase. The latter may, in part, be attributed to the presence of a small amount of tuberculin in the milk. This variation in the constituents of the milk would indicate that while under examination with tuberculin the milk of the animals should either not be used at all, or close attention paid to the fact that tuberculin will cause such variations. These results are but preliminary to a more extended examination."

Bovine tuberculosis, A. T. NEALE (*Delaware Sta. Rpt. 1893, pp. 81–102*).—The condition of public sentiment and the prevalence of bovine tuberculosis in the State are discussed at length. Ten herds, comprising 344 cows, were examined by the station veterinarian. Of these 89 animals were condemned. A rise of 1.5° in the temperature of an animal was sufficient for condemnation. The average expense for tuberculin exceeded 50 cts. per head. "About 1 cow in every 10 thus far killed and examined by this station for tuberculosis had a consumptive udder."

The method of disinfection followed by the station was to spray the stables with a 1 per cent solution of chlorid of lime in a spraying pump worked under a pressure of more than 100 lbs. to the square inch. A small quantity of whitewash was added to the solution in order to mark the thoroughness of the work. This solution "when driven through the air by heavy pressure charges the barn so heavily with chlorin gas that laborers are sorely tried while carrying out the work. A barn thus sprayed and closed for a few hours must be regarded as sterilized as thoroughly as circumstances will allow." Tabulated data give the temperature records of the animals tested with tuberculin.

Anthrax, A. T. NEALE (*Delaware Sta. Rpt. 1893, pp. 60–81*).—This general discussion of anthrax is largely a reprint of Bulletin 20 of the station (E. S. R., 5, p. 413). The use of Pasteur's preventive vaccine for anthrax is discussed, and experiments in which the use of vaccine failed to give immunity against the disease are briefly described. The Delaware law relative to the reduction of infectious and contagious diseases among the lower animals is given.

Ringworm (Trichophyton tonsurans) in cattle, A. T. NEALE (*Delaware Sta. Rpt. 1893, pp. 59, 60*).—An outbreak of ringworm, followed in several instances by death, is noted. "Mercurial ointments, spirits of camphor, salicylic acid, and especially tincture of iodin are recommended for local application."

Texas or splenic fever, A. T. NEALE (*Delaware Sta. Rpt. 1893, pp. 39–47*).—A reprint of Bulletin 23 of the station (E. S. R., 6, p. 81).

The use of Koch s lymph in the diagnosis of tuberculosis in cattle, J. NELSON (*New Jersey Stas. Rpt. 1893, pp. 209–285, dgms. 5*).—This article was printed as Bulletin 101 of the station (E. S. R., 6, p. 332).

Diseases of stock, R. R. DINWIDDIE (*Arkansas Sta. Rpt. 1894, pp. 1–22*).—A reprint of Bulletin 25 of the station (E. S. R., 5, p. 995).

Diseases of man and of domestic animals spread by dogs, O. HENNING (*Agl. Jour. Cape Colony, 8 (1895), No. 2, pp. 55, 56*).

Veterinary work of the Mississippi Station (*Mississippi Sta. Rpt. 1893, pp. 43–46*).—Reference is made to publications of the station treating of anthrax or charbon, diseases of sheep and calves, dehorning, glanders, and colic. Preventive treatment and symptoms of anthrax are discussed, and prescriptions to be used in the treatment of cramp colic and wind colic are given.

DAIRYING.

Fluctuation in the volatile acids of butter fat, C. L. PENNY (*Delaware Sta. Rpt. 1893, pp. 183–191*).—In this study the volatile fatty acids were determined in samples of butter from a large creamery taken at frequent intervals from September 16, 1891, to December 22, 1893. During the first year the samples were kept some time, often a year or more, before the volatile acids were determined. After that the samples were saponified, usually on the same day the butter was made. In all 118 samples were tested, and the results are tabulated, with the averages by months. The changes by months are also illustrated by a diagram.

"Inspection of the table shows that the results vary greatly and very suddenly within the same month, frequently much more than the averages of successive months; and the same month in 2 successive years shows wide differences probably due to more permanent causes. There would seem to be no relation between season and percentage composition of butter fat that is not overbalanced and entirely hidden by other disturbing causes. But following the changes from month to month it will appear that there is great uniformity of tendency. At certain times in the year the percentage of volatile acids, whatever it may happen to be for the year and under the particular circumstances, falls off rapidly, at other times it increases slowly and again rapidly. The falling off in percentage of volatile acids appears to be relatively abrupt. At a particular time of the year we can not say with any approximation to certainty what the proportion of volatile acids will be, but we may say with some confidence that at a certain season it will be increasing, at another decreasing. From July to September in the year 1892 this proportion is quite different from what it is during the same months of 1893, yet the rate of increase is substantially the same and also the same as that found by Spallanzani.[1] From September there is a rapid decline, continuing in our experience till October or November, in [Spallanzani's] to December. There is then an almost continuous rise till June, when there is an instant falling off to July. The two maximum points are September and June, the two minimum points from October to December, or late autumn, and July. The fact that the results for the same month of different years vary so rather emphasizes these tendencies. Then if the quality of butter improves with a higher percentage of volatile acids, the best butter ought to be made in June and in September, the poorest in July and in the late autumn. The minimum percentage in the above table is 21.77 on October 3, 1891, the maximum 32.23 on May 4, 1893. . . . The results are believed to show as fairly as may be the effect of season alone on the composition of butter-fat. The extreme fluctuations here reported are naturally less wide than might be found between samples from different individual cows."

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[1] Staz. Sper. Agr. Ital., 32 (1889), March.

A scheme for paying for cream by the Babcock test in butter factories, J. M. BARTLETT (*Maine Sta. Bul. 15, 2d ser., pp. 4, pl. 1*).—In this bulletin a popular detailed description is given of the method of carrying out the payment for cream at creameries on the basis of its weight and fat content, instead of its volume alone. The cream is to be weighed by the collector and a small sample taken by means of a sampling tube, and placed in a 2-oz. bottle marked with the patron's number. Upon arrival at the creamery the small sample bottles are emptied into the composite sample jars of the respective patrons, and these composite samples preserved by means of bichromate of potash for 2 weeks (4 weeks in winter), when they are tested by the Babcock tester. The method of paying for the cream from the results of the test is illustrated.

In the sale of milk, which offers the more profitable market, the creamery or a milk association of Philadelphia? A. T. NEALE (*Delaware Sta. Rpt. 1893, pp. 19–21*).—The financial record is given by months of two dairymen, one of whom sent his milk to Philadelphia and the other to a creamery which paid by test. The first sent 33,214 qts. of milk to Philadelphia during the year, receiving $1,027.23 net or 3.1 cts. per quart. The milk averaged 4.3 per cent of fat for the year. The second sent 33,214 qts. of 5 per cent milk to the creamery, receiving $1,076.84. Had the first sent his 4.3 per cent milk to the creamery he would have lost $101.04, and had the second sent his 5 per cent milk to the city he would have lost $49.63. "That is, in the city trade, no distinction in price is made between a product with 5 per cent and one with 4.3 per cent of butter. Yet on 33,214 qts. of milk, this difference on the creamery basis amounted to $150.67."

Test of hand separator, C. L. PENNY (*Delaware Sta. Rpt. 1893, p. 192*).—The power required to run a DeLaval Baby Separator at the rate of 41 turns per minute was found to be 0.1 horsepower. Run at 47 turns per minute the skim milk contained 0.1 per cent of fat.

The preparation of a new drink from milk, A. BERNSTEIN (*Deut. landw. Presse, 22 (1895), No. 14, pp. 119, 120*).

Inoculation in the manufacture of koumis, P. SPALLANZANI (*Staz. Sper. Agr. Ital., 28 (1895), No. 1, pp. 43–52*).

Flaack's milk sterilizer (*Deut. landw. Presse, 22 (1895), No. 7, pp. 56, 57*).

The Patterson method for determining the amount of butter-fat in milk (*Mississippi Sta. Rpt. 1893, pp. 48–50*).—An account of a modification of the Beimling method, previously described in Bulletin 21 of the station (E. S. R., 4, p. 267).

AGRICULTURAL ENGINEERING.

Tile drains, S. M. TRACY (*Mississippi Sta. Rpt. 1893, pp. 37–40*).—Accounts are given of attemps at the station during 1889–'93 to tile drain "creek bottom lands underlaid by a very heavy, almost impervious, black soil and clay; black prairie soils; and 'seepy' clay hillsides." The effect of the tiles was evident not only in removal of excess of water but in mitigation of drought on soils subject to it.

"When the drains have been less than 500 ft. in length we have found 3-in. tile ample for draining the ground quickly and thoroughly, but for longer runs we have found it necessary to use 4-in. for the lower part of the drains, and this has been of sufficient size for the extremities of the longest runs, about a quarter of a mile. The tile have been put into the ground to an average depth of 3½ ft. and the expense of the work, including the cost of tile, digging the ditches, laying and covering the tile has been 51 cts. per running rod. Three-inch tile have cost, including freight, about $18 per thousand feet, which is nearly three times the cost of such tile in Illinois and other Northern States. . . .

"The station fields which have been tile drained have increased their annual yield fully 50 per cent as a result of the work, and such drains will be found a profitable investment on all soils which remain wet until late in the spring on account of their compact subsoil, or which are rendered heavy and 'sour' by continued seepage from surrounding hill lands."

The artesian wells of southern Wyoming, their history and relation to irrigation, J. D. CONLEY (*Wyoming Sta. Bul. 20, pp. 87–122, figs. 2*).—The conditions necessary for an artesian supply are explained; the extent of artesian irrigation in San Bernardino, California, and the San Luis Valley, Colorado, is noted; and a detailed account of the artesian wells of southern Wyoming, principally in the vicinity of Laramie and Rawlins, is given, including data relating to cost, flow, strata pierced, and analyses of the water.

In an appendix is given the official analyses of water from artesian wells sunk by the Union Pacific Railway Company in Wyoming.

Brush and stone drains (*Cult. and Country Gent., 1895, Feb. 7, p. 103, figs. 2*).—Popular directions for the construction of these drains.

Subirrigation (*Rural New Yorker, 1895, Feb. 2, p. 66*).—A system of subirrigation by means of tile drains is described, which is claimed to overcome most of the objections to irrigation by means of tiles.

The trials of oil engines at Cambridge (*Jour. Roy. Agr. Soc. England, 3d ser., 5 (1894), No. 20, pp. 696–738, figs. 25*).

The animal as a prime mover, II, R. H. THURSTON (*Jour. Franklin Inst., 139 (1895), No. 830, pp. 100–121*).—A study of power and efficiency.

Electricity as a motive force for plows, RINGLEMAN (*Jour. Agr. Prat., 59 (1895), No. 3, pp. 89–99, figs. 5*).

Irrigation principles, W. HALL (*Irrigation Age, 8 (1895), No. 2, pp. 45–47; No. 3, pp. 83–85*).

Beet harvesting machine, BEHRENS (*Landw. Wochenbl. Schles. Holst., 45 (1895), No. 4, p. 57, figs. 2*).

Petroleum motor in agriculture, BRUTSCHKE (*Wochenschr. Pom. ökon. Ges., 25 (1895), No. 2, pp. 14, 15*).

Results of trials of potato diggers, F. SCHOTTE (*Jahrb. deut. landw. Ges., 9 (1894), pp. 395–410, figs. 15*).

Machines for peeling potatoes, F. SCHOTTE (*Jahrb. deut. landw. Ges., 9 (1894), pp. 389–394, figs. 4*).

Plans for a piggery, MALOCHOWSKI (*Jahrb. deut. landw. Ges., 9 (1894), pp. 411–416, figs. 3*).

STATISTICS.

Reports of director and of treasurer of Arkansas Station (*Arkansas Sta. Rpt. 1894, pp. V–VIII, 84, 85*).—A brief review of the year, a financial statement for the fiscal year ending June 30, 1894, and a list of the bulletins published by the station since July, 1891.

Arkansas Southern Branch Station, R. L. BENNETT (*Arkansas Sta. Rpt. 1894, pp. 87–89*).—Brief general remarks on the work at this substation.

Financial statements for 1893 and 1894 (*California Sta. Rpt. 1893 and 1894, pp. 495, 496*).—Financial statements for the fiscal years ending June 30, 1893 and 1894.

Report of treasurer of Delaware Station (*Delaware Sta. Rpt. 1893, pp. 4, 5*).—This is for the fiscal year ending June 30, 1893.

Reports of director and of treasurer of the Mississippi Station for 1893 (*Mississippi Sta. Rpt. 1893, pp. 1–6, 46, 52*).—Report of the treasurer for the fiscal year ending June 30, 1893, and brief outlines of the work of the year in the different departments at the station and at the branch stations at Holly Springs, Lake, and Booneville.

Reports of directors and of treasurers of New Jersey Stations (*New Jersey Stas. Rpt. 1893, pp. 1–16, 191–199, 203–206*).—Brief general remarks on the work of the year, treasurers' reports for 1893, and legislation relative to the station and fertilizer control.

Work of American experiment stations, E. W. HILGARD (*California Sta. Rpt. 1893 and 1894, pp. 42–44*).—A brief survey of the experiment station movement in this country, with remarks on the scope and purposes of station work, and the value of their studies and investigations from a practical and scientific point of view.

Report of observations made on European agricultural schools and experiment stations, 1892–'93, E. W. HILGARD (*California Sta. Rpt. 1893 and 1894, pp. 27–41*).—An interesting account of observations made in Germany and Switzerland.

MISCELLANEOUS.

The beginnings of agriculture, L. BOURDEAU (*Pop. Sci. Monthly, 1895, Mar., pp. 678–688*).

Socialism and agriculture in France, D. ZOLLA (*Ann. Agron., 21 (1895), Nos. 2, pp. 49–75; 3, pp. 97–122*).

Agriculture in the immediate vicinity of Berlin, ORTH (*Jahrb. deut. landw. Ges., 9 (1894), pp. 132–136*).

Notes on the agricultural features of the Congo, F. HAMBURSIN (*Ingén. Agr. Gembloux, 5 (1895), No. 7, pp. 325–330*).

Crops and live stock in Ontario (*Ontario Bureau Industries Bul. 52, pp. 16*).—Statistics on the condition of crops, live stock, etc., with extracts from returns of correspondents.

NOTES.

Arizona Station.—A greenhouse 24 by 80 ft. is in process of construction. At the Mesa substation deciduous, fruit, and ornamental trees have been planted, and at the Willcox substation tests are about to be made of pumping with a gasoline engine for irrigation purposes.

Indiana Station.—George R. Ives, formerly assistant agriculturist, has severed his connection with the station.

New Hampshire College.—On March 14 the college herd was reduced by the sale of 25 head at public auction. All the animals thus sold had been twice subjected to the tuberculin test. The State legislature has appropriated the sum of $25,000 to be expended by the College of Agriculture and Mechanic Arts in the building and furnishing of a residence and industrial hall for women.

South Dakota Station.—At the January meeting of the regents of education, J. H. Shepard, chemist of the station, was appointed director, *vice* Lewis McLouth, relieved; H. B. Mathews, meteorologist, was made assistant chemist, and the station council was reorganized and its powers and duties somewhat enlarged. Its number has been increased by the addition of one member from each of the governing boards, G. J. Coller being elected regent member and O. T. Grattan trustee member. L. C. Corbett, horticulturist, has been elected secretary and vice director of the council.

Wisconsin Station and College.—The following changes have been made in the governing board of the station: H. B. Dale, C. Keith, and N. D. Fratt have retired and are succeeded by O. H. Fethers, of Janesville; F. W. Challoner, of Oshkosh, and W. A. Jones, of Mineral Point.

The board of instruction of the college has been changed as follows: C. H. Diener has been appointed assistant in agricultural physics; F. E. Baker, assistant in judging live stock; F. Cranefield, assistant in horticulture; G. P. Pfeiffer, assistant in farm dairying; A. J. Schoenmann, assistant in milk testing; W. A. Voigt, instructor at pasteurizer; and T. A. Stanley, instructor in farm bookkeeping, has been succeeded by O. M. Taylor; E. J. Bennet, instructor in farm dairying, has been succeeded by J. D. Clark; W. E. Doane, instructor at butter worker, by F. B. Fulmer; E. H. Hageman and F. Walker, instructors at separators, by L. P. Biddick and J. A. Robinson; and J. E. Knott and F. Wismer, instructors in cheese making, by Julius Bird and John Kelty.

EXPERIMENT STATION RECORD.

VOL. VI. No. 10.

Efforts are continually being made in certain parts of Europe to discredit American clover seed. During the last two or three years, on account of the drought in Europe during the summers of 1893 and 1894, the importation of American seed greatly increased and an outcry was made to beware of such seed on account of insect larvæ, weed seeds, and general worthlessness. Some of the statements published seem to be inspired, not so much from a desire to protect consumers from real danger, as to bring the products of this country into disfavor.

The danger of introducing insect pests is very remote, and the purity and vitality of American clover seed will compare favorably with that grown in any part of the world. A prominent exporter has recently said that clover seed is sold abroad almost entirely by sample and that qualities are furnished to suit the intelligence and conscience of the buyers, hence the responsibility of placing a low grade of seed on foreign markets rests upon the importer. American dealers send their seed to the Federal Seed-Control Station at Zurich, Switzerland, for certification, and it ranks with that of any country in purity, vitality, and intrinsic worth. That weed seeds are found in American clover seed is not to be denied, but the same is true of European seed. Two lots of white and yellow clover seed, varieties little grown for seed in this country, reported upon in a recent Austrian report, contained 19 and 21.6 per cent of foreign seeds, a considerable proportion of which was clover dodder, a plant more injurious to clover than all the native weeds found in our clover fields.

In an article published in a reputable German agricultural journal, a list is given of 50 species of weed seed said to have been found in American clover seed. Thirty of the species enumerated are of European origin and 9 are not specifically determined, leaving but 11 species of certain American origin. The same author attempts to determine the part of the United States in which the clover seed grew from the accompanying weed seed. In making the city from which the seed was exported stand for the group of States adjacent to it he shows

ignorance of the trade conditions of this country. He claims that seed of *Phacelia tanacetifolia* was found in considerable quantity in clover seed received from Baltimore, and that this seed is characteristic of the Atlantic group of States when in reality the plant is a Pacific Coast form.

In a later article he has determined a lot of seed as belonging to some member of the order *Tiliaceæ*, but from the description and figures given it is plainly not the seed of *Tilia*, and the only other genera in this country of this order, *Corchorus* and *Triumfetta*, are not grown in the regions producing clover seed. He insisted for a time that seed of *Rumex acetosa*, a pernicious European weed, were to be found in nearly all American-grown seed. Fortunately for us he was mistaken in the determination, as this weed has but a limited distribution in this country. Other of his determinations are doubtful.

That foreign seed is not above suspicion may be seen from reports of the various European seed-control stations, where it is shown that seed of high quality has been mixed with old seed which has been colored or with finely crushed colored quartz. American ingenuity has devised machines for cleaning seed that are said to be superior to any others, and importers can readily obtain American clover seed of good quality if they desire to do so.

By a recent order of the Secretary of Agriculture a dairy division is to be organized in the Bureau of Animal Industry for the purpose of collecting and disseminating information relating to the dairy industry of the United States. Maj. Henry E. Alvord, formerly president of the Maryland Agricultural College, who is widely known for the prominent part he has taken in promoting the interests of agricultural education and investigation in this country, and who has a high reputation as an expert in dairy matters, has been appointed chief of the new division.

THE PHYSICAL PROPERTIES OF THE SOIL.[1]

DR. EWALD WOLLNY.

PART 2.

III.—THE BEHAVIOR OF THE SOIL TOWARD WATER.

The moisture of the soil comes partly from atmospheric precipitation, partly from ground water. With a given amount of water the degree of saturation of a soil may vary widely, depending upon (1) physical condition, (2) depth, (3) position, (4) covering of the soil, and (5) course of the meteorological elements.

INFLUENCE OF THE PHYSICAL CONDITION OF THE SOIL.

In this connection we must consider the various causes which bring about the numerous complicated processes in the soil.

Conduction of water in the soil.—If we suppose the soil to possess a separate grain structure, the spaces between the grains may be regarded in their continuity as tubes, which possess capillary properties if the particles are sufficiently small. The capillarity ceases when the diameter of the particles is more than 2 mm., and varies with smaller particles than these to a greater or less extent according to the fineness of the grains.

With regard to the height to which water can be lifted from a lower layer, and to the velocity with which this occurs, there is the general law that water will be lifted the higher and the more slowly the finer the soil particles and the richer the soil in colloid ingredients. Different soils vary widely in this respect. Capillary height for clay often exceeds 2 meters, but for sand of medium fineness it is generally less than 0.4 meter. While, however, the maximum height is soon reached in sands, the rise in clays is very slow.

Similar behavior is observed in the conduction of water supplied from above. The percolation of water through the soil meets with a certain amount of resistance, due partly to capillarity, partly to adhesion and friction between the water and the soil particles, all of which increase with the fineness of the grains and the quantity of the colloid substances present. Hence the depth and velocity of the percolation are inversely proportional to the size of the grains and the richness of the soil in colloid substances.

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[1] Continued from p. 774.

The large spaces occurring in tilled soils retard the capillary rise of water, but, on the other hand, increase the velocity with which water penetrates downward from the surface, often to a remarkable degree. If crumbly soils are pressed together (rolled), the upward movement of water is increased in proportion to the increase in density, but the percolation of atmospheric water is retarded. The presence of stones diminishes the capillary rise of water in the soil in proportion to the quantity of stones present, and the same is true of the percolation of water.

In soils which are made up of layers of different physical constitution the passage of water from one layer to another, either upward or downward, is hindered more and stopped sooner the wider the difference between adjacent layers in the fineness of their particles or in their other physical properties. Water rises or sinks from a coarse-grained to a fine-grained layer much more readily than the reverse.

The capillary movement of water in a soil occurs only when considerable water is present. It ceases when the soil contains 30 to 50 per cent (according to the fineness of the particles) of the quantity of water required for saturation, and instead there is a very much slower movement of water from the surface of one particle to that of another. If the water envelopes are diminished beyond a certain limit the movement of water ceases altogether.

Capillary rise and percolation of water in the soil declines as the water content of the soil diminishes, because the so-called surface tension of the liquid increases at the same time.[1]

The water-holding capacity of the soil.—The quantities of water in soils are best expressed in percentages of the volume of the soil occupied by water. The old method of expressing the water in percentages by weight is misleading on account of the variations in the specific gravity of soils.[2]

After movement ceases water is retained in the soil by surface attraction and also by the affinity of the colloid substances for water. Other things being equal, the quantity of water stored up by the soil is greater the finer the soil particles and the greater the quantity of colloid material present.

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[1] Meister, Programm des Jahresberichtes 1857–'58 der k. landwirthschaftlichen Centralschule Weihenstephan. W. Schumacher, Physik des Bodens, 1894, p. 91. F. Haberlandt, Wissenschaftlich-praktische Untersuchungen auf dem Gebiete des Pflanzenbaues, 1, 1875, p. 9. A. Schleh, Ueber die Bedeutung des Wassers in den Pflanzen und die Regulirung desselben in unserer Culturböden, Inaugural-Dissertation, Leipzig, 1876. A. von Liebenberg, Ueber das Verhalten des Wassers im Boden, Inaugural-Dissertation, Halle, 1873. H. von Klenze, Landw. Jahrb., 1877, p. 83. A. Mayer, Lehrbuch der Agriculturchemie, II. W. Edler, Die capillare Leitung des Wassers in den durch den Schöne'schen Schlämmapparat abgeschiedenen hydraulischen Werthen, Inaugural-Dissertation, Göttingen, 1882. A. Mayer, Forsch. Geb. agr. Phys., 14, p. 254. E. Wollny, Ibid., 7, p. 269, and 8, p. 206.

[2] A. Mayer, Landw. Jahrb., 1874, p. 753.

On examining a moist column of soil, in which movement of water has ceased, it is found that the quantity of water increases on descending, and that above a certain height the quantity of water remains constant. The reason of this is that in the upper part the water is held only by surface attraction and the capillarity of the very fine interstices, while the water flows out of the larger spaces. In descending the column increasing amounts of water are held even by the larger interstices until finally if the particles are sufficiently fine the water is held even in the largest interstices and the soil is saturated. For this reason we distinguish between an absolute or minimum water capacity, representing the quantity of water held in the upper part of a sufficiently high column of soil by adhesion and in the finest capillaries, and a complete or maximum saturation, representing the quantity of water held by the soil when all the intergranular spaces are filled.[1]

The variations in maximum capacity for water in different soils, with the exception of extremely coarse samples, are comparatively small, because the spaces are approximately equal. (Compare p. 764.) On the other hand, the volume per cent of water corresponding to the minimum water capacity is remarkably variable in natural soils, and generally shows a considerable difference from the maximum capacity. The values for the two kinds of water capacity approximate only in soils which have very small particles and are rich in clay and humus. From these facts it will be seen that the maximum is of much less interest than the minimum water capacity in forming a judgment of a soil.

The minimum water capacity increases, other conditions being equal, with the fineness of the soil particles and the proportion of colloid substances present. It is diminished considerably by the formation of aggregates and increased by compressing the soil. Stones diminish the water capacity. With an increase of temperature the water capacity diminishes owing to the decrease in the viscosity of the water. Repeated freezing and thawing of the mass cause changes in the mechanical structure of clay soils which result in a lowering of the water capacity.[2]

Permeability of the soil for water.—This is very closely connected with the properties already described. It is this property of soils therefore which prevents their supersaturation.

Other things being equal, the quantity of water which filters through a soil may be considered a measure of its permeability. Experiments on this property have shown that the permeability of the soil for water increases with an increase in the size of the grains and a decrease of the quantity of colloid substances present. Clay, humus, and very

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[1] A. Mayer, Landw. Jahrb., 1874, p. 753.

[2] G. Schübler, Grundsätze der Agriculturchemie, 2, 1838. C. Trommer, Die Bodenkunde, 1857. Meister, l. c. W. Schumacher, l. c., p. 86. A. von Liebenberg, l. c. F. Haberlandt, l. c., 1, p. 9. A. Mayer, Fühling's landw. Ztg., 1875, p. 18. H. von Klenze, l. c., p. 122. E. Wollny, Forsch. Geb. agr. Phys., 8, p. 177.

fine sand, and concretions formed by precipitation (carbonate of lime, hydrated oxid of iron) or adhesion of particles (hardpan) are almost completely impervious to water. The high permeability of coarse soils may be considerably diminished by an admixture of fine-grained material. In stratified soils the permeability is controlled by that layer which is made up of the finest particles, even when the layer is thin. In crumbly soils the permeability is considerably greater than in powdery soils, and it decreases in loose soils when they are pressed together.

The quantity of water passing through the soil increases with the water pressure—not in the same proportion, but to a less degree. However, the differences in the quantity of water for a given material and thickness of layer corresponding to equal intervals of pressure are constant. Experiments have shown, further, that in fine-grained soils and at high pressures the quantity of water passing through the soil diminishes as the thickness of the layer increases; while in other soils and under lower pressures the relation of the quantity of water to the thickness of the layer is not as great, diminishing as the size of the grains increases.[1]

The power of evaporation of the soil.—This is most conveniently measured by the quantity of water given off by evaporation to the atmosphere from the unit of surface. The method of referring the evaporation to the weight of the soil is subject to the same objections urged against the determination of the water capacity according to the weight of the soil.

The quantity of water evaporated, where only the physical structure of the soil is considered, depends on (1) extent to which the factors determining evaporation (temperature, moisture, and movement of the air) exert their influence, and (2) the power of the lower layers of soil to supply the loss at the surface.

Evaporation increases with the extent of surface. Therefore the quantities of water given up to the atmosphere are greater from uneven and rough than from smooth surfaces. Evaporation is greatest from a southern exposure, next greatest from an eastern, next from a western, and least from a northern exposure. The quantity of water evaporated increases on a southerly and decreases on a northerly exposure with the inclination. For easterly and westerly exposures the influence of inclination on evaporation is hardly perceptible. When very wet, dark soils lose more water by evaporation than light-colored ones, but for dryer soils the reverse is the case.[2]

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[1] E. Wolff, Anleitung zur Untersuchung landw. wichtiger Stoffe, 1875, p. 74. C. Flügge, Ztschr. Biol., 13, p. 465. A. R. von Schwarz, Erster Bericht über Arbeiten der k. k. landw.-chemischen Versuchs-Station in Wien, 1878, p. 51. F. Seelheim, Archives Néerland. Sci. Exact. et Nat., 14, p. 393. D. von Welitschkowsky, Arch. Hyg., 2, p. 499. E. Wollny, Forsch. Geb. agr. Phys., 14, p. 1.

[2] C. Eser, Forsch. Geb. agr. Phys., 7, pp. 46, 47, 53, 97.

The influence of the physical structure of the soil on the evaporation is readily understood if the processes taking place are closely examined. If the water present at the surface of a wet soil passes into the atmosphere in the form of vapor, the pores near the surface are gradually emptied and the water in the next layer forced toward the surface. When this process is communicated to the layers farther down, an upward movement of water by capillarity occurs in the whole mass. In consequence of this process the quantity of water present in the soil diminishes until capillary movement ceases. From this point the water lost from the surface is no longer replaced, and the only remaining movement is that of water from particle to particle on their surfaces, which is very slow. In consequence, the surface of the soil dries up. The uppermost dry layer now hinders the direct influence of the agencies of evaporation, especially that of the wind. Evaporation, therefore, decreases rapidly after the upper layers dry up, and the resistance increases as the drying proceeds downward.

From the above it will be seen that the evaporation steadily decreases under long-continued dryness, and further, that the more easily the evaporated water is replaced the more rapid is evaporation and the slower a dry layer is formed, and *vice versa*. It is clear that saturated (wet) soils, irrespective of their mechanical constitution, allow approximately equal quantities of water to evaporate, and that the rate of evaporation, other things being equal, rises and falls with the humidity of the soil. Hence the evaporation capacity of a soil is intimately connected with its water capacity, and is greater in proportion to the fineness of the soil and to its richness in colloid substances, and *vice versa*.

In crumbly soils the evaporation is less rapid than in soils of separate grain structure because in the former case the noncapillary spaces retard the rise of water. Stones act in the same way. An increase in density increases the capillarity, and consequently the evaporation.

In soils of different depths evaporation increases with the height of the soil column up to a certain limit and then diminishes again in proportion to the increase in height. If there is water underneath the soil the evaporation decreases as the distance between the surface of this water and that of the soil increases and as the capillary rise diminishes.[1]

[1] G. Schübler, l. c. Meister, l. c. F. E. Schulze, Beobachtungen über Verdünstung, Rostock, 1860. E. Wolff, l. c., p. 61. W. Schümacher, l. c. and "Der Ackerbau," 1864, p. 62. J. Nessler, Landw. Correspondenzblatt für das Grossherzogthum Baden, 1860, p. 217. H. Hellriegel, Beiträge zu den naturwissenschaftlichen Grundlagen des Ackerbaues, Brunswick, 1863, p. 625. P. Wagner, Berichte über Arbeiten der Versuchs station Darmstadt, 1874, p. 87. A. Schleh, Inaugural Dissertation, Leipsic. F. Haberlandt, l. c., 2. S. W. Johnson, Rpt. Connecticut Agl. Expt. Sta. for 1877, p. 76. F. Masure, Ann. Agron., 8, p. 161. R. Heinrich, Grundlagen der Beurtheilung der Ackerkrume, 1882. E. Wollny, Forsch. Geb. agr. Phys., 3, pp. 117, 325, 328; 4, p. 360; 5, pp. 21, 157; Landw. Jahrb., 1876, p. 457. C. Eser, Forsch. Geb. agr. Phys., 7, p. 1.

The quantity of water present in the soil at any time is due to the combined action of the factors described as affecting the humidity of the soil, as well as to other influences. In general, the average quantity of water in natural soils is greater in proportion to the fineness of the particles and the quantity of clay and humus present. Of the different soil constituents humus holds as a rule the largest quantity of water, then follow in order clay, loam, and quartz. Soils having a separate grain structure show a much higher average humidity than crumbly soils. Stones diminish the percentage by volume of water in proportion to their quantity. With an increase in density we generally find a rise in humidity, other things being equal.

As may be seen, the variations of humidity in natural soils correspond in general to those of water capacity, because as a rule evaporation and permeability practically equalize each other, for generally a high evaporation is associated with a correspondingly low permeability, and *vice versa*. Nevertheless, these factors, especially evaporation, can under certain circumstances weaken or completely nullify the influence of the others. For instance, the values for the average humidity of soils of varying compactness are more nearly the same than those found for the water capacity under the same circumstances, because with the increase in density the evaporation increases, involving a more rapid loss of the stored-up water.[1] That evaporation is in many cases the most important factor influencing the humidity of the soil is shown by the fact that a soil of uneven surface and dark color contains less water than one of smooth surface and light color.[2] The stirring of the upper layer of soil at first increases the evaporation, but after a short time the loosened layer dries out and serves to prevent evaporation from the lower layers by diminishing the direct influence of the agencies of evaporation on the soil and by retarding the capillary rise of water to the surface.[3]

Variations in the humidity of the upper parts of the soil are caused by the accumulation of water in an impermeable layer in the subsoil. If this impermeable layer is near the surface, the water may come quite to the top of a level soil, in which case the soil is saturated. If the ground water is farther beneath the surface the influence on the humidity of the upper layers depends entirely on the conductivity of the layers. The higher the water rises by capillarity the greater the influence of the ground water on the humidity of the upper layers.

INFLUENCE OF THE DEPTH OF THE SOIL.

Experiments on this subject[4] have shown that the absolute humidity of the soil always increases with the thickness of the soil layer, and that the percentage by volume behaves in the same way up to a certain

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[1] E. Wollny, Forsch. Geb. agr. Phys., 5, pp. 1, 145.
[2] Ibid., 3, p. 117; 12, p. 386.
[3] Ibid., 3, p. 325.
[4] Ibid., 16, p. 1.

limit, above which it does not change with an increase in the depth of the soil. This limit varies considerably in different soils. It lies at that point where the capillary rise of water from the lower moist layers of the soil toward the surface ceases. It increases, therefore, with the ability of the soil to conduct water by capillarity, and *vice versa*. Variations in the humidity increase as the thickness of the soil diminishes.

INFLUENCE OF THE POSITION OF THE SOIL.

Inclination.—A level soil is, as a rule, moister than an inclined soil. If inclined, the moisture decreases with an increase in inclination. In the case of inclined soils the difference in moisture in the higher and lower parts of the soil increases with inclination.

Exposure.—In soils having different exposures, those facing the north have most moisture, then those toward the west, then the east, while those facing the south are driest. These differences increase with the angle of exposure.[1]

INFLUENCE OF THE COVERING OF THE SOIL.

The moisture content of a soil covered with plants during the period of growth is always lower, under like conditions, than one left bare. This is due to the rapid transpiration of water by living plants. This drying up of the soil, which is also noticed in timber lands, is greater in proportion to the development of the plants, the thickness of the stand, and the length of the period of growth. The influence on the humidity of the soil diminishes as the plants die off on approaching maturity, and is greatest when development of the aërial organs is greatest.

A covering of dead plants, straw, stable manure, etc., or of such materials as stones, gravel, wood, etc., increases the moisture of a soil during the warm seasons, because such a covering affords protection against evaporation. In general the moisture of the soil increases with the thickness of such a covering.

We see, then, that as a rule soils shaded by growing plants contain least moisture, soils covered with stones and other lifeless materials contain most, while those that are bare stand intermediate.[2]

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[1] E. Wollny, Forsch. Geb. agr. Phys., 9, p. 3; 10, p. 3.

[2] G. Wilhelm, Der Boden und das Wasser, Vienna, 1861; Wochenbl. für Forst- und Landw. in Württemberg, 1866, p. 174; Landw. und forst. Ztg., 1867, p. 31; Fühling's landw. Ztg., 1876, p. 40; Wiener landw. Ztg., 1874, p. 159. E. Risler, Chemischer Ackersmann, 1870, p. 131. W. Schumacher, Fühling's landw. Ztg., 1872, p. 604; 1873, p. 683. A. Vogel, Abhandl. der k. bayerischen Akad. der Wissenschaften, II. Classe, vol. 10, part II, 1867. J. N. Woldrich, Ztschr. österr. Ges. Meteorol., 6, No. 8. E. Ebermayer, Die physikalischen Einwirkungen des Waldes auf Luft und Boden, Berlin, 1873; Forsch. Geb. agr. Phys., 12, p. 147. E. Wollny, Der Einfluss der Pflanzendecke und der Beschattung auf die physikalischen Eigenschaften und die Fruchtbarkeit des Bodens, Berlin, 1877; Forsch. Geb. agr. Phys., 10, pp. 261, 415; 12, p. 21; 13, p. 134; 14, p. 138; 17, p. 171. R. Lorenz von Liburnau, Wald, Klima und Wasser, 1878. E. Ramann, Die Waldstreu, 1890; Forsch. Geb. agr. Phys., 11, p. 299; Forstliche Bodenkunde, 1893, p. 255.

THE INFLUENCE OF METEOROLOGICAL ELEMENTS.

This can not be disregarded if we wish to obtain a clear insight into the cause of the widely varying condition of moisture of soils under natural conditions, because the physical properties of the soil itself are influenced by the average course of the elements (climate) and their behavior at different times (weather).

The effects of climate may be thus generally stated: A higher degree of moisture in the soil accompanies copious precipitation, greater humidity of the atmosphere, moderate movement of the air, lower temperature and greater water capacity of the soil, while a drier condition of the soil is caused by the reverse circumstances. For a particular case the effects can only be understood by knowing the course of the individual elements and the constitution of the soil.

The relation of the weather to the humidity of the soil is many sided.

Although the quantity of precipitation in the countries of middle Europe is smaller during the cold season than during the warmer parts of the year, the wetting of the soil is very much more complete in the former than in the latter case on account of the diminished evaporation due to a lower temperature. This is particularly true of soils covered with plants, because the latter, as a rule, use up the water obtained by the soil from the atmosphere during the period of growth, and sometimes a part of the water stored up during the cold season also.[1] From these facts it follows that the water collected in the soil during the period of no growth (winter moisture) may, under certain circumstances, be very important for vegetation.[2]

In the dry season the influence of evaporation is as a rule predominant. In long periods of dryness evaporation may cause an equalizing of humidity in soils of different physical constitution, independently of how high the moisture was originally.[3] The differences in humidity between covered and bare soils show themselves more strongly, however, under such circumstances. This is also true for uneven, dark-colored soils, compared with smooth light-colored soils.[4]

Winds influence evaporation to a remarkable degree, and therefore exert a great influence on the humidity of the soil. The evaporation varies with the velocity of the wind. In the case of westerly and northerly winds, which are moist as a rule, the evaporation is less than

[1] E. Wollny, Der Einfluss der Pflanzendecke und der Beschattung auf die physikalischen Eigenschaften und die Fruchtbarkeit des Bodens, Berlin, 1877, p. 119; Forsch. Geb. agr. Phys., 4, p. 85. F. von Höhnel, Mitt. aus dem forst. Versuch. Oesterr., 1879; Forsch. Geb. agr. Phys., 4, p. 435.

[2] G. Havenstein, Landw. Jahrb., 7.

[3] C. Eser, Forsch. Geb. agr. Phys., 7, p. 1.

[4] E. Wollny, Der Einfluss der Pflanzendecke und der Beschattung auf die physikalischen Eigenschaften und die Fruchtbarkeit des Bodens; Forsch. Geb. agr. Phys., 3, p. 147; 12, p. 386.

in the case of easterly and southerly winds, which are generally dry.[1] [This, of course, is not universally true.—Ed.]

During the rainy period the precipitation serves first to replace the water evaporated during the preceding period—that is, to remoisten the soil. The saturation of the soil takes place in different ways according to the conductivity and water capacity of the soil. Fine grained soils which conduct water slowly are only moistened to a slight depth, and in consequence of this the water accumulates to a greater or less extent on the surface in the case of level land, or flows away if the ground is sloping. Soils of this kind store up during a copious precipitation of long duration more water than corresponds to their water capacity, because the water percolates slowly. The greater the permeability of the soil the easier the water sinks and the thicker the layer of soil which is moistened. A high degree of permeability, therefore, lessens the storage of water, since more or less of the rainfall passes down into the depths of the soil. Soils of this kind are most uniformly moistened when there is at each precipitation not more water than the soil can retain. From this we see the importance of greater frequency of precipitation for such soils. The need of frequent precipitation decreases as the water capacity increases and permeability decreases, because the water supplied to the soil is stored up to a greater or less extent. In extreme cases—that is, with difficultly permeable soils—a less frequent but more copious supply of water must be regarded as more advantageous.[2]

In as far as the humidity depends on the texture of the soil, the quantity of water stored up during the wet season corresponds almost exactly to the water capacity of the soil. When, on the other hand, the differences in soil moisture are caused by those in evaporation, precipitation may cause an equalization of the quantities of water stored up. Therefore the variation in soil moisture due to difference in character (evenness, color) of the surface, or to difference in covering, exposure, and inclination, may during long rainy periods or the colder seasons become more or less completely equalized.

From the fact that the atmospheric precipitation serves first to replace the water lost by evaporation during a period of dryness, and that an excess sinks down or collects only when the soil is saturated, we must infer that the quantity of percolating water and the height of the ground water can not be ascertained from the permeability of the soil or quantity of precipitation alone. The general facts in this connection are summarized below.

THE QUANTITIES OF PERCOLATING WATER.

In soils destitute of plant life the quantity of percolating water varies with the atmospheric supply, but in a ratio which depends on the phys-

[1] J. A. Henselc, Forsch. Geb. agr. Phys., 16, p. 311.

[2] E. Wollny, Forsch. Geb. agr. Phys., 14, p. 138. Compare also p. 853.

ical structure of the soil, character of its surface, distribution of the precipitation, and the season. The greater the evaporation and the water capacity and the less the permeability of the soil, the smaller is the quantity of percolating water, other things being equal. For these reasons percolation diminishes in proportion to the increase of fine particles (clay and humus) in the soil or to the decrease of large noncapillary spaces, and *vice versa.* The downward flow of water increases with the thickness of the soil layer up to a certain limit (about 60 cm.), above which an increase in thickness is without influence on percolation. In the case of light-colored, loose, and even surfaces the percolation is greater than in dark-colored, compact, and uneven surfaces. The covering of a soil with lifeless material (dead plants, stones, coarse-grained soils) causes a considerable increase, while a covering of living plants causes a remarkable decrease in the amount of percolating water. The influence of the distribution of precipitation on the absolute quantity of water carried off from beneath the surface is shown in the fact that the largest quantities of percolating water in bare soils occur in seasons of greatest precipitation. Those districts where the soil freezes and becomes impermeable in winter form an exception to this rule. In such cases drainage is generally suspended until the spring. With regard to the ratio of the water percolating through the soil to the quantity of precipitation, it is generally true that relatively the larger proportion of the water supplied is carried away by drainage when the season is coldest. In soils covered with living plants the quantities of percolating water do not follow the course of precipitation, but are greatly reduced by transpiration by plants. For these reasons the greatest percolation occurs in all cultivated regions irrespective of the distribution of moisture in the cold season of no growth, in winter or in spring, according to the predominance of warmth.[1]

THE HEIGHT OF THE GROUND WATER.

Variations in the height of the ground water depend partly upon the physical structure of the soil, partly upon the quantity and distribution of precipitation. In horizontal strata the height of the ground water depends upon the depth of the impermeable subsoil, and approaches nearer to the surface of the soil in proportion to the coarseness of the

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[1] J. Dalton, Mem. Lit. Phil. Soc. Manchester, 5, part II. J. Dickenson, Jour. Roy. Agr. Soc., 5. Maurice, Bibl. univ. Genève, Sci. et Arts, 1. Gasparin, Cours d'Agriculture, 2, p. 116. G. von Möllendorff, Die Regenverhältnisse Deutschlands, 1862. E. Risler, Arch. des Sci. de la Bibl. univ., 1869. F. Pfaff, Sitzungsber. königׄ. bayer. Akad. Wissensch., 1 (1868), p. 311; 2 (1869), p. 125. J. N. Woldrich, Ztschr. österr. Ges. für Meteorol., 6, p. 97. J. H. Gilbert, Proc. Inst. Civil Engineers, 45, part III; 105, part III. E. Ebermayer, Die physikalischen Einwirkungen des Waldes auf Luft und Boden, Berlin, 1873, p. 215; Forsch. Geb. agr. Phys., 12, p. 147; 13, p. 1. E. Wollny, Der Einfluss der Pflanzendecke und der Beschattung auf die physikalischen Eigenschaften und die Fruchtbarkeit des Bodens, Berlin, 1877, p. 137; Forsch. Geb. agr. Phys., 10, pp. 1, 321; 17, p. 180.

soil and its poorness in clayey and humus materials. In periods of drought the variations in the level of the surface of the ground water increase with the thinness of the permeable layer in which the water occurs, and with the ease with which the water is raised by capillarity. In bare soils and in those covered with lifeless materials the ground water rises and falls with the quantity of precipitation so long as the water table does not reach the surface. In soils covered with living plants no ground water collects during the period of growth even when the soil is very deep (1.2 meters or more), or at least only temporarily.[1]

THE DISTRIBUTION OF WATER IN THE SOIL.

From what has been already said it is readily understood that the moisture, as a rule, increases with the depth. This is true of all soils as long as there is no precipitation and no downward movement of water. In case of a soil of low permeability or one covered with strongly transpiring plants a thorough moistening of the upper layers occurs only when atmospheric moisture is supplied. Under these circumstances more water is contained in the upper layer temporarily than in the lower strata, and a dry layer may occur between the upper and lower moist layers if the rain is not sufficient for complete saturation—an occurrence observed quite frequently in soils covered with plants during the summer.

According to Hofmann[2] we may conveniently distinguish three soil layers. First there is a superficial zone of evaporation, in which the degree of moisture varies from complete saturation to great dryness. In this zone in case of a dry, hot summer the whole of the summer and late autumn precipitation may often be absorbed without filling up the capillary pores down to the lower limit of the zone. In such cases an intermediate dry layer always exists between the upper layer, temporarily moistened by precipitation, and the deeper water-conducting layer. Below this superficial zone, then, there lies the so-called transition zone, which is that part which is never dried up, but which always has its capillary pores filled with water. If this second zone receives water from above after the superficial layer has been completely saturated with water it does not retain it, but allows the excess to sink into the third zone—that of the ground water.

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[1] Hofmann, Arch. Hyg., 1. J. Soyka, Der Boden. Pettenkofer and Ziemssen, Handbuch der Hygiene, 1887, p. 251; Die Schwankungen des Grundwassers. A. Penck, Geographische Abhandlungen, 1888, 2, No. 3. E. Wollny, Forsch. Geb. agr. Phys., 14, p. 332.

[2] Arch Hyg., 1 and 2, No. 2.

RECENT WORK IN AGRICULTURAL SCIENCE.

CHEMISTRY.

The estimation of nitrogen in feeding stuffs by the Kjeldahl method, GERLACH and SÜVERN (*Chem. Ztg.*, *18* (*1894*), *No. 97*, *pp. 1902*, *1903*).—A number of determinations of nitrogen by the Kjeldahl method in cotton-seed meal, rice meal, and peanut meal showed that varying the time of digestion from 2 to 12 hours caused an increase of scarcely 0.1 per cent. The use of concentrated sulphuric acid containing 150 gm. of phosphoric anhydrid to the liter secured practically the same results. The average of a number of blank determinations showed that about 0.03 per cent of nitrogen was obtained from the air in the digestion flask after 12 hours' digestion. The authors therefore conclude that the use of phosphoric anhydrid is unnecessary, and that a digestion of from 2 to 3 hours is sufficient. The small additional amount of nitrogen obtained after a long digestion is doubtless from some compound other than albuminoids and would play a small part in the economic value of the feeding stuffs.—J. P. STREET.

Note on the Kjeldahl method for nitrogen, O. KELLNER, O. BÖTTCHER, and G. DIESSELHORST (*Chem. Ztg.*, *19* (*1895*), *No. 3*, *p. 35*).—An answer to the above article of Gerlach and Süvern, showing that the total nitrogen can not be obtained from products like cotton-seed meal by digesting from 2 to 3 hours unless the sulphuric acid contains phosphoric anhydrid and metallic mercury is added.—J. P. STREET.

On the preparation of ammonium citrate solution, R. DE ROODE (*Jour. Amer. Chem. Soc.*, *17* (*1895*), *No. 1*, *p. 47*).—If in making the citrate solution it is made decidedly alkaline with ammonia and allowed to stand over night, in the morning the solution will be found to be strictly neutral. The addition of a small quantity of salicylic acid (1 gm. to 5 liters) before neutralizing will prevent the growth of fungus in the solution.—J. P. STREET.

Some facts observed in the determination of phosphoric acid by the molybdic acid process, R. DE ROODE (*Jour. Amer. Chem. Soc.*, *17* (*1895*), *No. 1*, *pp. 43–46*).—Experiments are briefly reported from which the author draws the following conclusions:

"(1) Our present method [official] for determining phosphoric acid seems to give results which are somewhat too high.

"(2) The results obtained by using a large quantity of substance, and obtaining large precipitates, are lower and somewhat more accurate than those obtained where smaller quantities are employed.

"(3) Somewhat lower and more accurate results are obtained by using a blank made by employing a dilute solution of a phosphate, which is added to each determination. This blank, previously determined, being substracted from the final result.

"(4) Accurate results, agreeing with those obtained by the use of the blank, are obtained by redissolving the magnesium pyrophosphate and reprecipitating.

"(5) Five minutes' digestion at 65° C. seems to be sufficient for the complete precipitation of phosphoric acid by molybdic solution."—R. H. LOUGHRIDGE.

The determination of phosphoric acid, H. PEMBERTON, Jr. (*Jour. Amer. Chem. Soc.*, *17* (*1895*), *No. 3*, *pp. 178–181*).—The author calls attention to several points in his method (E. S. R., 5, p. 444). In preparing the standard alkali the indicator used should be phenolphthalein and not methyl orange, as the latter is affected by the alumina usually contained in potassium hydroxid. In heating the solution it should be brought to a full boil. It will then take care of itself and does not need any definite temperature for proper precipitation. In precipitating, the aqueous molybdate should be added slowly, stirring frequently, thus obtaining a purer precipitate.—J. P. STREET.

The determination of potash in manures, W. E. GARRIGUES (*Jour. Amer. Chem. Soc.*, *17* (*1895*), *No. 1*, *pp. 47–51*).—Work 10 gm. of the sample into a paste with concentrated sulphuric acid in a platinum dish. Ignite, raising the heat gradually until the residue is white, or red if iron be present. Grind the residue in a mortar to a fine powder, add a little hot water, and triturate the mass for a few minutes. Wash into a 500 cc. flask and boil with 250 cc. of water for 30 minutes, and then run in a 10 per cent solution of barium chlorid, 5 cc. at a time, boiling after each addition, until no further precipitation is visible. Add sodium carbonate until a faint permanent rose color is obtained with phenolphthalein. Boil for a minute, cool, and fill to the mark. Filter, add hydrochloric acid in slight excess to 50 cc. in a porcelain dish, and evaporate on a water bath with platinic chlorid. Wash the precipitate with alcohol (sp. gr. 0.848), dry at 100° C., and weigh. For potash salts, the ignition with sulphuric acid is omitted.

The sulphuric acid must be added cautiously to prevent loss from the violent reaction, when chlorids and nitrates are present. The ignited mass must be pulverized very finely, to prevent the occlusion of potash by the calcium sulphate. An excess of sodium carbonate must be avoided, as double decomposition may take place.

While the method does not, in common with those now in use, return quite all the potash, it is claimed that it is no less accurate, and gives less discordant results than the Lindo-Gladding, besides being more satisfactory to work and quicker. One filtration and evaporation only are entailed, but a greater quantity of platinic chlorid is required.—J. P. STREET.

The addition of calcium chlorid to the solution of a fertilizer in the determination of potash, R. DE ROODE (*Jour. Amer. Chem. Soc.*, *17* (*1895*), *No. 1*, *p. 46*).—Experiments made by the author indicate that

in the presence of ammonia and some ammonium oxalate or carbonate the addition of calcium chlorid does not result in the formation of tricalcium phosphate in the solution prepared as directed in the official methods, and hence "the very object for which the calcium chlorid is added is defeated."

The determination of woody fiber in fodders, A. P. AITKEN (*Analyst, 20 (1895), Feb., pp. 35–37*).—The author follows the conventional method of digesting with $1\frac{1}{4}$ per cent acid and alkali, but overcomes the difficulties of frothing and change of strength by evaporation by abandoning boiling. "I now use beakers, which I immerse in a steam bath and which I cover with watch glasses. The result is that the solutions are maintained at the temperature of boiling water and no evaporation takes place, so that the strength of the solution does not alter and the subsequent washing of the residues and their final removal from the beaker to a filter or Gooch crucible is easy. The extraction of the soluble matters is not so rapid, . . . but three quarters of an hour in the steam bath is equivalent to half an hour's boiling." The conditions being more uniform, successive determinations "give results of great uniformity."

Extraction of the fat was mentioned as advisable in the case of oil cakes. In the discussion following the paper Mr. Dyer regarded incomplete extraction of the oil, either before or after treatment with acid or alkali, as a frequent source of error. Mere alkaline treatment failed to saponify more than a fraction, sometimes only a moderate fraction, of the oil.

Quick estimation of starch, P. L. HIBBARD (*Jour. Amer. Chem. Soc., 17 (1895), No. 1, pp. 61–68*).—Place enough of the finely pulverized material to contain at least 0.5 gm. of starch in a flask with about 50 cc. of water, and add 1 or 2 cc. of malt extract. Heat to boiling, shaking frequently to prevent the formation of clots of starch. (The addition of diastase before gelatinizing the starch helps to prevent this, as it acts above the temperature at which the starch becomes pasty.) After boiling a minute, cool to 50 to 60° C., and add 2 to 3 cc. malt extract. Heat slowly from 10 to 15 minutes till boiling, again partially cool, and test with iodin solution. If there is a blue reaction, another addition of malt must be made. When all the starch is changed, cool the mixture, make up to definite volume, and filter through fine linen or muslin. Place an aliquot part of the filtrate, containing 0.2 or 0.3 gm. of starch, in a 100 cc. flask with 5 cc. hydrochloric acid, containing 30 per cent of hydrochloric acid, and water to make about 60 cc. total. Boil for 30 minutes on a sand bath, cool, nearly neutralize with sodium hydroxid, and determine the dextrose by Fehling's solution. The method is said to be simple, rapid, and fairly accurate.—J. P. STREET.

Method of estimating acidity of milk, M. SCHAFFER (*Staz. Sper. Agr. Ital., 26 (1894), pp. 164–167; abs. in Jour. Chem. Soc., 67–68 (1895), Mar., p. 94*).—An apparatus is used consisting of 3 bulbs, 2 holding about 50 cc. each connected by a narrow graduated tube, and the third

below holding 2 cc. The upper bulb is stoppered. In making a test 2 cc. of phenolphthalein is placed in the lowest bulb, then 50 cc. of milk, measured on the graduated tube, and 2 to 2.5 cc. one fourth normal soda solution, and mixed, not shaken. Soda is added until alkaline, and the quantity used is read off on the graduated tube connecting the 2 large bulbs.

The relation between specific gravity, fat, and solids-not-fat in milk, H. D. RICHMOND (*Analyst, 20 (1895), Mar., pp. 57, 58*).—A simplification of Richmond's new formula to

$$T = \frac{G}{4} + \frac{6}{5} F + 0.14,$$

in which T=total solids, G=lactometer reading, and F=fat.

"The results will not differ (in extreme cases) more than 0.02 from the other formula." The formula may be further simplified to

$$T = 0.25\ G + 1.25\ F, \text{ or } T = \frac{G+5\ F}{4}$$

"and this second formula is correct within 0.2 per cent up to 6 per cent fat. It is still more accurate if 0.05 per cent be added for each 1 per cent above 3 per cent, and subtracted for each 1 per cent below 3 per cent."

The detection of saccharin in beer, F. GAULTER (*Rev. Internat. Falsif., 8 (1894), p. 47; abs. in Chem. Centbl., 1895, I, No. 3, p. 175*).—The author finds that the resin present in beer produces a fluorescence when treated with resorcin and sulphuric acid, and for this reason holds that Börnstein's reaction is uncertain. To obviate this difficulty he evaporates to a sirup, adds a few drops of hydrochloric acid, extracts with 95 per cent alcohol, evaporates the alcoholic extract to a sirup, extracts with ether, and evaporates to dryness. The residue is then extracted with hot water, and the saccharin obtained from the water as a yellowish crystalline substance.—W. D. BIGELOW.

Notes on the estimation of iron and alumina in phosphates, K. P. MCELROY (*Jour. Amer. Chem. Soc., 17 (1895), No. 4, pp. 260–263*).

Contribution on the estimation of nitric acid, R. BERGER (*Chem. Ztg., 19 (1895), No. 15, pp. 305, 306*).—A volumetric method based on the same principle as the Schulze-Tiemann. The method has been successfully used in the analysis of saltpeter, and in the determination of the amount of nitric acid in sulphuric acid.—J. P. STREET.

The determination of potash in kainit, R. DE ROODE (*Jour. Amer. Chem. Soc., 17 (1895), No. 2, p. 85*).—The evaporation of "an aliquot portion of a filtered aqueous solution of kainit directly with platinum chlorid" is claimed to give accurate results.

The oxidation of organic matter and the decomposition of ammonium salts by aqua regia in lieu of ignition, in the determination of potash in fertilizers, R. DE ROODE (*Jour. Amer. Chem. Soc., 17 (1895), No. 2, pp. 86, 87*).—The details of the method have not yet been worked out.

On the determination of cane sugar in the presence of commercial glucose, H. A. WEBER and W. MCPHERSON (*Jour. Amer. Chem. Soc., 17 (1895), No. 4, pp. 312–320*).—This article appeared originally in the Proceedings of the Association of Official Agricultural Chemists for 1894.[1]

[1] U. S. Dept. Agr., Div. of Chemistry Bul. 43, pp. 126–131.

On the action of acetic and hydrochloric acids on sucrose, H. A. WEBER and W. MCPHERSON (*Jour. Amer. Chem. Soc., 17 (1895), No. 4, pp. 320–327*).—This article appeared originally in the Proceedings of the Association of Official Agricultural Chemists for 1894.[1]

Water determination in raw sugar, GUNNING and ALBERDA (*Sucr. Belge, 23 (1894), p. 108; abs. in Chem. Ztg., 18 (1894), No. 100, Repert., p. 313*).

A new method of estimating glucose by alkaline copper solution, ALLEIN and GAUD (*Jour. Pharm. et. Chim., 30 (1894), pp. 305–307; abs. in Analyst, 20 (1895), Jan., p. 21*).

Concerning the influence of the presence of lead acetate on the results of determinations of invert sugar by the Fehling-Soxhlet method, A. BORNTRÄGER (*Ztschr. angew. Chem., 1895, No. 4, pp. 103, 104*).

Preservation of starch solution, H. KRÁL (*Pharm. Cent. Halle, 15 (1894), p. 606; abs. in Analyst, 20 (1895), Jan., p. 23*).

A new method of estimating milk fat, P. FERNANDEZ-KRUG and W. HAMPE (*Ztschr. angew. Chem., 1894, No. 22, pp. 683–687; abs. in Analyst, 20 (1895), Jan., p. 20*).

An easy method for the examination of butter mixed with foreign fats, C. KILLING (*Abs. in Chem. Ztg., 18 (1894), No. 100, Repert., p. 314; and in Milch Ztg., 23 (1894), No. 49, pp. 781, 782*).—The method is based on the determination of the viscosity of butter, for which a special apparatus has been devised, too complex for description here.

The separation of solid and fatty acids, E. TWITCHELL (*Jour. Amer. Chem. Soc., 17 (1895), No. 4, pp. 289–295*).

Contributions to acid-butyrometry according to Gerber, P. HAUSMANN (*Chem. Ztg., 19 (1895), No. 17, pp. 348–350*).—A comprehensive comparison of the methods of Gerber, Babcock, and Thörner for the determination of fat in milk. From a tabulation of the experience of a number of analysts with the 3 methods, the Gerber method appears to be preferable because of its simplicity, ease of manipulation, and cheapness.—J. P. STREET.

Refractometer for the examination of butter (*Pharm. Centbl., 1894, No. 33; abs. in Milch Ztg., 24 (1895), No. 3, pp. 40–42*).—A new refractometer, essentially a simplification of the Abbé instrument, and especially adapted to inspection work.—J. P. STREET.

Polarization-microscope and Zeiss' refractometer for the examination of butter, C. BESANA (*Staz. Sper. Agr. Ital., 26 (1894), p. 601; abs. in Chem. Ztg., 18 (1894), No. 96, Repert., pp. 294, 295*).

The use and value of the butyro-refractometer of Abbé-Zeiss, J. DELAITE (*Abs. in Chem. Ztg., 19 (1895), No. 16, Repert., p. 57*).

The estimation and numerical expression of color in tanning materials, J. G. PARKER and H. R. PROCTOR (*Jour. Soc. Chem. Ind., 14 (1895), No. 2, pp. 124–127*).

Estimation of saccharose in malt, E. JALOWETZ (*Abs. in Chem. Ztg., 18 (1894), No. 96, Repert., p. 294*).

Wine analysis, ROESLER (*Forsch. ü. Lebensmtl., 1 (1894), pp. 347–351; abs. in Chem. Centbl., 1894, II, p. 499*).—The article defines grape wine (Natur- und Vollweine und Halbwein), fruit wine and artificial wine, and gives the characteristics of each, and permitted and prohibited additions before and after fermentation. Methods for the examination of wines are also given.—W. D. BIGELOW.

Detection of salicylic acid in wine, E. CLAASSEN (*Pharm. Rundschau, 13 (1895), No. 2, pp. 38, 39*).

Estimation of phosphoric acid in sweet wine, E. LÁSZLÓ (*Chem. Ztg., 18 (1894), No. 91, p. 1771*).

Proportion of dextrose and levulose in sweet wine and honey, J. KÖNIG and W. KARSCH (*Ztschr. analyt. Chem., 34 (1895), No. 1, pp. 1–18*).

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[1] U. S. Dept. Agr., Div. of Chemistry Bul. 43, pp. 131–135.

Titration with Fehling's solution in wine analysis, A. BORNTRÄGER (*Ztschr. analyt. Chem., 34 (1895), No. 1, pp. 19–35*).

Date wine and fig wine, A. MAITRE (*Jour. Pharm. et Chim., 1894, ser. 5, No. 30, p. 339; abs. in Chem. Centbl., 1894, II, No. 23, p. 933*).

Estimation of mannite in wine, J. A. MULLER (*Bul. Soc. Chim. Paris, 12–13 (1895), No. 22, pp. 1073–1080*).—This article is a continuation of that published by the author in the same journal, 10–11 (1893), p. 333.

Constant level apparatus, J. C. CHORLEY (*Analyst, 20 (1895), Jan., p. 16, fig. 1*).—This is designed for use in distillations where it is desirable to maintain a constant level in the distilling flask.

Apparatus for preserving and delivering standard solutions, J. C. CHORLEY (*Analyst, 20 (1895), Jan., p. 15, fig. 1*).

The use of the Mohr-Westphal balance in milk analysis, C. H. WOLFF (*Ztschr. angew. Chem., 1895, No. 5, pp. 134–137, figs. 2*).

Examination of pectase and the pectic fermentation, G. BERTRAND and A. MALLÈVRE (*Bul. Soc. Chim. Paris, 12–13 (1895), No. 2, pp. 77–82*).

The alkaloids of Corydalis cava—Corybulbine, J. J. DOBBIE and A. LAUDER (*Jour. Chem. Soc. London, 67 (1895), Jan., pp. 25–30*).

Concerning the leucin resulting in pancreas digestion, R. COHN (*Ztschr. physiol. Chem., 20, No. 1 and 2, pp. 203–209*).

Concerning fungus cellulose, E. WINTERSTEIN (*Ber. deut. bot. Ges., 13 (1895), No. 2, pp. 65–70*).—A study is given of fungus cellulose prepared by various methods.

Note on fungus cellulose, E. WINTERSTEIN (*Ztschr. physiol. Chem., 20, No. 3, p. 342*).

Contributions to the chemistry of cellulose, I, A. L. STERN (*Jour. Chem. Soc. London, 67 (1895), pp. 74–90*).—This first paper is on cellulose-sulphuric acid and the products of its hydrolysis.

The carbohydrates of yeast, E. SALKOWSKI (*Ber. deut. chem. Ges., 27 (1895), No. 19, pp. 3325–3328*).

The furfurol-yielding constituents of plants, C. F. CROSS, E. J. BEVAN, and C. BEADLE (*Jour. Amer. Chem. Soc., 17 (1895), No. 4, pp. 286–289*).

The yellow coloring matters of Sophora japonica, E. SCHUNCK (*Jour. Chem. Soc. London, 67 (1895), Jan., pp. 30–32*).

Essential oil of hops, A. C. CHAPMAN (*Jour. Chem. Soc., 67 (1895), Jan., pp. 54–63*).

Theories of the formation of sugar, E. DUCLAUX (*Ann. Inst. Pasteur, 9 (1895), No. 2, pp. 120–128*).—A critical review.

Variations in the sugar compounds during the germination of barley, P. PETIT (*Compt. Rend., 120 (1895), No. 12, pp. 687–689*).

Transformations of fibrin by the prolonged action of dilute saline solutions, A. DASTRE (*Compt. Rend., 120 (1895), No. 11, pp. 589–592*).

A compendium of agricultural chemistry (Précis de chimie agricole), E. GAIN (*Paris: J. B. Baillière et fils, pp. 436, figs. 93. Reviewed in Ing. Agric. Gembloux, Apr., 1895, p. 475*).—The principal divisions are plant nutrition, composition of plants, fertilization of the soil, and the chemistry of agricultural products.

BOTANY.

The action of the water of the soil on vegetation, E. GAIN (*Rev. gén. Bot., 7 (1895), Nos. 73, pp. 15–26; 74, pp. 71–84; 75, pp. 123–138, figs. 2*).—The author reviews his own work and that of other investigators in the following lines: (1) The amount of water in arable soils, (2) physical and chemical action of water on the substances which plants assimilate from the soil, and (3) the biological effects of dryness or humidity of the soil.

It is pointed out, among other things, that the moisture of the soil has a marked influence upon the activity of the microörganisms of the soil which aid in the nutrition of plants, especially the root tubercle bacteria.[1] The author's experiments lead to the conclusion that a medium amount of moisture in the soil (50 per cent of that required for complete saturation) is as a rule more favorable to the development of root tubercles than higher or lower amounts.

The results of experiments relating to the biological effects of dryness and humidity on 6 different kinds of soils indicate that different plants behave in the same manner as regards resistance to drought, but that the amount of moisture destructive to plants varies with the stage of growth. It is possible, therefore, to trace a curve for each species, showing its water requirements at every period of growth.

As regards the influence of the moisture of the soil on absorption and transpiration by plants, experiments indicate that (1) the saturation of a soil previously dry produces marked disturbances in the flow of sap; (2) transpiration varies with the water content of the soil, being greater the higher this content; and (3) when the maximum of turgescence is passed transpiration decreases, there being in fact a maximum of turgescence for each moment of growth at which the functions of nutrition are most active.

The effect of decapitation on plant organs, B. ROTHERT (*Trans. Assn. Naturalists, Imp. Univ. Kazan, 26* (*1893*), *No. 5, p. 77, figs. 2*).—The present investigations were conducted by the author to test the statement of Darwin that the cotyledons of *Phalaris canariensis*, the tops of which had been cut off, did not undergo any heliotropic curving, while those which were uninjured curved rapidly and strongly; from which Darwin concluded that the top of the cotyledon was sensitive to light and that heliotropic curving of the lower part of the cotyledon is caused by irritation transmitted to it from the top, and that the loss of heliotropism was due to removal of the sensitive part of the shoot.

Following the methods of experiment pursued by Darwin the author conducted a series of experiments with etiolated plants of *Phalaris canariensis*, in which he proved that decapitation produces but a temporary disappearance of heliotropic curving.

A second series of experiments was conducted with *Avena sativa* and also *P. canariensis*, in which the action of the two are so nearly alike that they are described together. From 4 to 7 mm. of the tips were cut from the oats, and from the canary grass the portions removed varied from ½ to 7 mm. The experiments proved that the disappearance of heliotropic curving was evidently produced by the wounding of the shoots and is not to be attributed to the removal of the irritating effect when the top is cut. The belief that the disappearance of heliotropic curving might be due to temporary arresting of growth of the rest of the shoots caused the author to conduct a series of experi-

[1] Compt. Rend., 116 (1893), No. 24, pp. 1394–1396 (E. S. R., 5, p. 112).

ments in which various zones were marked off on the growing shoots, and the growth of uninjured and decapitated shoots compared. From the experiments it is shown that decapitation always causes considerable decrease of growth. This decrease is most marked in the zone nearest the cut, where in some cases there is no growth shown, but on descending toward the base of the shoot the difference between the growth of the decapitated and sound plants becomes greatly reduced. It was also shown that the decrease in growth was the strongest at the beginning of the experiment and became less as the later measurements were made. Decapitation decreases the normal rate of growth fully one fourth, and this reduction in growth will be shown in the diminished curvature when compared with the normal rate of growth in shoots which causes strong curving in a few hours.

The author conducted a series of experiments to determine why the decapitated plants did not undergo heliotropic curving. A number of plants in which heliotropism had been induced were decapitated and compared with uninjured shoots, showing that it was due to decapitation temporarily destroying the heliotropic sensitiveness. The remaining part of the shoots is insensible to the irritation caused by one-sided illumination. Decapitation in this case caused a strong diminution in the rate of growth, and temporarily caused a total loss of sensitiveness toward external irritants.

A series of experiments was conducted in which vertical incisions in or near the top of the cotyledon were made to ascertain whether this form of injury would have the same effect on heliotropism as decapitation. But little effect was noticed, showing, in the author's estimation, that the phenomena described above are not due to the wounding of the shoots, but are to be attributed exclusively to the removal of the connection between the top and the remaining body of the cotyledon.

Since the specific irritation produced by decapitation acts downward from the cut along the cotyledon, the author made some experiments to ascertain whether this irritation is transmitted to any considerable distance or whether its effect is circumscribed within narrow limits. He found that if the top is cut off for several millimeters the action extends over the entire length of the shoots; but if ½ to 1 mm. is removed the action is carried to a much less distance, the time which transpires before the effect of decapitation manifests itself varying from 3 to 6 hours, and the heliotropic sensitiveness of the decapitated shoots was reëstablished within 24 hours. The characteristic unequal distribution of the sensitiveness of the shoot was arrested and the upper end became more sensitive than the lower part, showing that a regeneration of the injured top had taken place in the upper end of the decapitated shoot as soon as the physiological properties of the normal top were restored, proving that these properties do not reside in any definite morphological part of an organ and are not connected with any definite anatomic structure. It is further shown that shoots decapitated after

the induction of heliotropism become not only insensible to heliotropic irritation, but also to geotropic, and that decapitation has the same effect on geotropism of shoots as it has upon heliotropism.

Experiments were conducted which showed that the loss of geotropic curving is due to the loss in rapidity of growth and also the loss of geotropic sensitiveness. Experiments by the author show that the top of the cotyledon possesses a very strong geotropic sensitiveness, and that being concentrated at or near the top of the cotyledon it must be admitted that the geotropic irritation is transmitted downward from the top along the cotyledon. Otherwise the geotropic and heliotropic curving would have been different instead of showing the same phenomena.

The author's conclusions are that decapitation of the cotyledons of *Gramineæ* (*Avena sativa*, *Phalaris canariensis*, *Setaria viridis*) causes two effects independent of each other, namely, a strong retardation of growth, and the loss of geotropic and heliotropic sensitiveness. If the top is cut from plants where heliotropism and geotropism has been induced in the shoots the curving is due to after action and they will not respond to the new action of irritants. The effects of decapitation last but a few hours, after which the rapidity of growth as well as susceptibility to irritants are gradually restored and at the end of 24 hours become altogether normal. Experiments on *Avena sativa* show that the previously unequal distribution of heliotropic sensitiveness is destroyed. In experiments with shoots of *Brassica napus* décapitation produced effects essentially the same so far as the principles involved are concerned.

Concerning copper from the standpoint of toxicology, A. TSCHIRCH (*Das Kupfer vom Standpunkte der gerichtlichen Chemie, Toxikologie und Hygiene; abs. in Chem. Ztg., 18 (1894) No. 102, Repert., p. 329*).—The author, contrary to the opinions of many others, says that copper is not injurious to plants. The salts of copper, such as the sulphate, chlorid, nitrate, etc., are corrosive and do exert an injurious effect on plant life. Plants grown in soil that contained insoluble copper compounds are said to have taken up some of this copper without any injury. Water cultures of *Phaseolus multiflorus* were grown in nutrient solutions containing 2 gm. of copper oxid to every 3 liters of the solution. The roots were thoroughly aërated from time to time and no injury was apparent to the plants. Experiments were made with 36 culture plants under the above conditions and their growth was stronger and the plants appeared more vigorous than parallel cultures where the nutrient solution contained no copper.

Synopsis of North American Amarantaceæ, II, E. B. ULINE and W. L. BRAY (*Bot. Gaz., 20 (1895), No. 2, pp. 155–161*).—A revision of the species of *Acnida* and *Gomphrena* is given.

A revision of the genus Cordyceps, G. MASSEE (*Ann. Bot., 9 (1895), No. 33, pp. 1–44, pls. 2*).—The author enumerates 62 species, one of which, *C. velutipes*, is described as new. Of those fully described 22 species are peculiar to the Old World, 23 to the New World, and 6 are common to both.

A popular treatise on the physiology of plants, P. SORAUER (*Translated by F. E. Weiss. London and New York: Longmans, Green & Co*).

Anatomy of the leaves of Arctic plants, F. BOERGESEN (*Jour. Bot. France, 9 (1895), No. 1, pp. 1–7; No. 2, pp. 21–27*).—In the main the conclusions are the same as given by G. Bonnier (E. S. R., 6, p. 616).

A contribution to the comparative anatomy of coniferous fruits, M. RADAIS (*Ann. Sci. Nat. Bot., 19 (1894), No. 3–6, pp. 165–368, pls. 15*).

Aërial roots of carnations, B. D. HALSTED (*Garden and Forest, 8 (1895), pp. 158, 159*).—An account is given of the presence of aërial roots on carnations. The author thinks their presence was probably due to surplus moisture as well as a tendency of some individual plants to throw out such roots.

Concerning the opening mechanism of flowers, C. STEINBRINCK (*Ber. deut. bot. Ges., 13 (1895), No. 2, pp. 55–61, figs. 5*).

Concerning the opening and closing of flowers, F. OLTMANNS (*Bot. Ztg., 53 (1895), I, No. 2, pp. 31–52*).

The spontaneous movements of leaves of the Leguminosæ and Oxalideæ, A. RODRIGUE (*Bul. Soc. Bot. France, 41 (1894), pp. CXXVIII–CXXXIV*).

The functions of the beards on barley, A. ZOEBL and C. MIKOSCH (*Sitzungsber. kgl. Akad. wissensch. Wien, 1892; abs. in Ann. Agron., 21 (1895), No. 3, pp. 143, 144*).

Concerning the structure and arrangement of the laticiferous tissue with special reference to gutta-percha and caoutchouc bearing plants, O. CHIMANI (*Bot. Centbl., 61 (1895), Nos. 10, 11, and 12, pp. 353–360, 385–395, and 417–426*).

Some factors influencing the health of plants under glass, B. T. GALLOWAY (*Amer. Florist, 10 (1895), pp. 930–932*).—An address delivered before the New York Florists' Club, April 8, 1895.

Remarks concerning the necessary amount of light for plants, J. WIESNER (*Ber. deut. bot. Ges., 12 (1894), Generalversammlungs number, 1895, Feb. 12, pp. 78–89*).

The effect of diastatic ferments on reserve cellulose, J. GRUSS (*Ber. deut. bot. Ges., 12 (1894), Generalversammlungs number, 1895, Feb. 12, pp. 60–72*).

The existence and localization of emulsin in Manihot spp., L. GUIGNARD (*Bul. Soc. Bot. France, 41 (1894), pp. CIII–CVII*).

On the presence of essence of wintergreen in various plants, E. BOURQUELOT (*Bul. Soc. Bot. France, 41 (1894), pp. XXXVII–XL*).—In addition to species of *Gaultheria* and *Betula* it is reported as found in *Polygala* spp. and *Monotropa hypopytis*.

On the distribution of phosphorus in plants, G. POLLACCI (*Malpighia, 4, No. 8 and 9, p. 19; abs. in Bot. Centbl., 61 (1895), No. 11, pp. 399, 400*).

On the classification of mucilage found in plants, L. MANGIN (*Bul. Soc. Bot. France, 41 (1894), pp. XL–XLIX*).—The various kinds of mucilage are classified according to their action toward certain chemicals, into cellulose, pectose, callous, mixed and intermediate.

The reasons for the disappearance of reserve material in seeds (*Flora, 79 (1894), pp. 419–429; abs. in Bot. Centbl. Beihefte, 5 (1895), No. 1, p. 23*).

The nutrition of green plants by glycerin, E. ASSFOHL (*Jour. Pharm. et Chim., 14 (1894), ser. 5, No. 12, p. 558; Ann. Agron., 1894, Oct. 28*).

Phenological notes on abnormal inflorescence observed in the autumn of 1893, A. MAGNIN (*Ann. Soc. Bot. Lyons, 19 (1894)*).

Concerning the symbiosis of Helianthus tuberosus and H. annuus induced by grafting, H. VÖCHTING (*Sitzungsber. kgl. Akad. wissensch. Math. phys. Classe, 1894, July 12; abs. Bot. Ztg., 53 (1895), II, No. 7, pp. 112–115*).

A room for constant temperature, W. PFEFFER (*Ber. deut. bot. Ges., 13 (1895), No. 2, pp. 49–54, fig. 1*).—A description of an apparatus for regulating the temperature of a room.

Investigations on nuclear division, DEGAGNY (*Bul. Soc. Bot. France, 41 (1894), No. 8 and 9, pp. 588–596*).

The effect of the repression of certain bacteria through the continued cultivation of legumes, A. HILL (*Ztschr. landw. Ver. Hessen, 1895, No. 11, pp. 81, 82*).—The author claims that the continued cropping of legumes will fill the soil with only those bacteria concerned in the assimilation of free nitrogen to the entire displacement of all neutral forms.

Experimental evolution amongst plants, L. H. BAILEY (*Amer. Nat., 29 (1895), pp. 318–325*).—An abstract of an address before the Massachusetts Horticultural Society, February 23, 1895.

Flowers and insects, XIV, C. ROBERTSON (*Bot. Gaz., 20 (1895), No. 4, pp. 139–149*).—A continuation of the observations of the author on the mutual adaptations of flowers and their insect visitors, with lists of insects observed to visit certain flowers.

Guide to the study of common plants, an introduction to botany, V. M. SPALDING (*Boston: D. C. Heath & Co., pp. 294*).

METEOROLOGY.

The needs of meteorology, C. ABBE (*Science, 1895, Feb. 15, pp. 181, 182*).—Considered as a source of climatological statistics and as a system for the prediction of the weather for a day or two in advance, meteorology has received enthusiastic support. About all that can be done by the utilization of the telegraph and weather map and the application of general average rules is now being done; but we are still powerless in the presence of any unusual movement of the atmosphere. Meteorologists must have a deeper insight into the mechanics of the atmosphere. It is not enough to know what the conditions have been and are, but we must know what they will be and why. A complete and rigorous deductive treatise on the laws governing the atmosphere is needed—a treatise on the application to the atmosphere of the dynamics and thermodynamics of gases and vapors. The preparation of such a work demands appropriate laboratory arrangements. Hence the great need of meteorology at present is the establishment of laboratories and the consecration of physicists and mathematicians to the science. The applications of climatology to geology, physiography, hygiene, irrigation, and other matters have been developed, but meteorology itself still remains to be provided for. Our universities should recognize the science to a greater extent in their courses of study and provide for meteorological laboratories.—O. L. FASSIG.

Rainfall and snow of the United States compiled to the end of 1891, M. W. HARRINGTON (*U. S. Dept. Agr., Weather Bureau Bul. C, pp. 80, fig. 1, charts 23*).—Tables give the annual precipitation in the United States (1738 to 1891); annual and seasonal averages, seasonal variation, and cubic miles for each State; mean daily rainfall for 18 to 28 years at 12 selected stations expressed as a percentage of days on which rain fell; combined averages of hourly occurrences of precipitation at Blue Hill Observatory, near Boston, Massachusetts, Washington, D. C., and Central Park, New York, New York; details of precipitation, and heaviest rainfalls at selected representative stations. Col-

ored charts (published separately) show rainfall (January to December), rainfall for seasons, rainfall for the year, snowfall (in inches), monthly maxima of rainfall, rainy seasons, monthly minima of rainfall, details of rainfall, and details of occurrence of thunderstorms. The text discusses, under the head of mean amounts of rainfall, least rainfall, greatest rainfall, topography and its effects on rainfall, snow, distribution by States, disposal of the rainfall, variation in the annual rainfall, daily rainfall, and hourly rainfall; under relative amounts of precipitation, curves, maximum monthly rainfall, rainy seasons, minimum monthly rainfall, probability of rain, and character of rainfall; under special features of rainfall, heaviest rainfall, consecutive days with and without rain, and thunderstorms.

"The statistics of rain and snow, here given, include the most important series of observations that have been made from the early settlement of the country to the close of the year 1891.

"The collection embraces the records originally contributed to the Smithsonian Institution in manuscript, and others collected by that Institution from private individuals, those from the published journals of scientific societies and other associations, those made under the direction of the Medical Department of the U. S. Army, the Lake Survey, the Regents of the University of the State of New York, the Central and Southern Pacific Railways, the various State Weather Services and meteorological associations, the Signal Service, and, finally, the Weather Bureau, which succeeded it."

Depth of snow on ground during February, 1895 (*U. S. Dept. Agr., Weather Bureau, Weekly Snow Charts for Feb., 1895*).—The charts for February show a very unusual extent of snow-covered ground during the greater part of the month. February 11 the entire country, with the exception of the southern portions of the Gulf States and the Pacific Coast, had a depth varying from 1 in. in the South to 15 in. in the Northwest and Northeast, and 35 in. in upper Michigan. By February 28 it had practically disappeared from all portions of the United States excepting the lake regions and the extreme Northeast.

The chart for Feb. 11 contains an interesting note relating to the cold period of Feb. 1 to 11.

"At a majority of stations over the central and southern portions of the country the minimum records for the first decade of February have been lowered. At Galveston and New Orleans, where the records cover nearly a quarter of a century, the minimum temperature of February 8 reached 14° and 16°, respectively, that at Galveston being 14° below any previous record of the first decade of February, the record at New Orleans being lowered by 9°."—O. L. FASSIG.

Monthly Weather Review (*U. S. Dept. Agr., Weather Bureau, Monthly Weather Review, 22 (1894), Nos. 9–11, pp. 351–485, charts 19*).—These numbers include the usual notes and summaries. Beginning with the September number a new section on "Meteorology and magnetism" is introduced.

"In response to the request of the chief of the Weather Bureau, the directors of the observatories at Toronto, Washington, and San Antonio have courteously undertaken to forward to the Bureau, as promptly as possible, certain data from their

magnetograms, namely, the mean ordinates for the day from 24 hourly readings of the horizontal force, the declination, and the vertical force, uncorrected for instrumental errors and changes of temperature. On days exhibiting very disturbed magnetic conditions the hours and the values of the maximum and minimum ordinates are given.

"The object in collecting these data is to institute a comparison between the crude magnetic readings, particularly of the bifilar, and the temperature changes at meteorological stations in the Northwest. Ultimately such comparisons will show how far unreduced magnetic observations may be available for determining the direction and the intensity of the temperature variations and other weather conditions before these become fully developed, as given by the isotherms and isobars of the daily weather maps. It has already been shown that weather and magnetism conform on the average to a normal type, but the problem of the synchronous changes from day to day is still under advisement as a practical feature in forecasting."

Wreck and casualty chart of the Great Lakes, 1894 (*U. S. Dept. Agr., Weather Bureau, 1 chart with text, 25 by 36 in., Feb., 1895*).—This chart gives in detail the number of casualties occurring on Lakes Superior, Michigan, Huron, Erie, and Ontario, and the connecting rivers during the season of 1894, and includes besides the record of total loss of 44 vessels and cargoes, involving a loss of $643,243, the partial loss of 68 vessels and cargoes to the amount of $349,544, and the sacrifice of 68 lives.—O. L. FASSIG.

Meteorology in France during 1892, E. MASCART (*Ann. Bureau Central Météorol. France, 1892, 3 vols. Paris: 1894*).—The following memoirs occur annually in volume I of this series: Summary of thunderstorms in France; magnetic observations made at the observatory of Parc Saint-Maur; magnetic observations made at the observatory of Perpignan; magnetic determinations made in France; study of the progress of the phenomena of vegetation and the migration of birds; meteorological observations made at the Central Meteorological Bureau and upon the Eiffel Tower. Besides the above annual reports the volume contains: First series of meteorological observations made on Mont Blanc in 1887, by J. Vallot; remarks upon the observations made on the summit of Mont Blanc in 1887, by A. Angot; summary of studies of the progress of phenomena of vegetation and the migration of birds in France during the 10 years 1881–'90, by A. Angot; squalls and thunderstorms, by E. Durant-Gréville.

Volume II contains the observations made during the year at 126 stations in France, 36 stations in Algeria, and at 23 colonial stations. Volume III contains a detailed statement of rainfall at 409 stations in France.—O. L. FASSIG.

Rainfall of the Hawaiian Islands, J. HANN (*Meteorol. Ztschr., Wien (1895), pp. 1–14*).—The islands lie in the heart of the northeast trades. According to McKibben, the trades prevail during 258 days at Honolulu. This insures a constant temperature, but great variation in rainfall in the mountainous regions.

The greatest precipitation occurs on the windward side of the southeasterly and largest of the islands, Hawaii, which has a maximum fall

of about 600 cm. (240 in.). The minimum fall occurs on the southern plains of Oahu and along the southwest coast of Maui, reaching scarcely 40 cm. (16 in.).

Rainfall at Honolulu.

Month.	1873–'92.	1881–'90.	Month.	1873–'92.	1881–'90.
	Cm.	*Cm.*		*Cm.*	*Cm.*
January	101.6	73.2	August	58.0	64.3
February	116.3	127.3	September	46.9	49.9
March	96.0	180.0	October	57.9	56.1
April	79.2	85.4	November	131.3	133.7
May	80.2	86.9	December	124.8	120.1
June	46.1	44.2			
July	63.3	66.1	Whole year	1,001.9	1,015.2

—O. L. FASSIG.

Rainfall in Tacubaya, Mexico, M. MORENO Y AUDA (*Bol. Obs. Astr. Nat. de Tacubaya, vol. 1, No. 20, pp. 324–329, pl. 1*).—The following is a summary of results during 10 years (1884–'93):

Rainfall during 10 years in Tacubaya, Mexico.

Year.	Rainfall.		No. of rainy days.		Total rainfall.
	Jan. to June.	July to Dec.	Jan. to June.	July to Dec.	
	Mm.	*Mm.*			*Mm.*
1884	143.3	349.2	21	71	492.5
1885	143.6	535.4	35	69	679.0
1886	169.9	413.0	25	53	582.9
1887	355.2	491.3	43	74	846.5
1888	199.5	432.7	29	83	632.2
1889	236.7	476.5	39	64	713.2
1890	297.2	495.3	35	82	792.5
1891	287.3	495.7	41	69	783.0
1892	160.6	325.2	39	52	485.8
1893	287.3	439.7	48	75	727.0
	228.1	455.4	35.5	69.2	683.5

The monthly normals calculated from the 10 years' observations are as follows:

Monthly normal values, 1884–'93.

Month.	Millimeters.	Month.	Millimeters.
January	2.3	July	107.5
February	5.3	August	140.1
March	14.9	September	128.4
April	21.2	October	62.5
May	48.5	November	12.4
June	136.0	December	4.6
Total	228.1	Total	455.4

—O. L. FASSIG.

Meteorological observations at Upsala, Sweden, 1894, H. H. HILDEBRANDSSON (*Bul. mensuel Observ. Météorol. Univ. Upsala, 26 (1894), pp. 74*).—The records for pressure, temperature, humidity, direction, and velocity of wind are given in hourly values.

The mean temperature for the year was 6° C.; mean maximum, 10.2°; mean minimum, 1.6°; humidity, 81; cloudiness, 6.1; and rainfall, 486.5 mm.—O. L. FASSIG.

Meteorological observations at Porto Rico, 1894 (*Resumen observ. meteorol. verif. Jefatura de Obras Públicas Isla Puerto-Rico, 1894*).—The summary for the year is as follows: Maximum temperature at the surface of the ground, 36° C.; maximum temperature in the shade, 33.2°; mean temperature in the shade, 23.1°; minimum temperature, 14°; total rainfall, 1,227.7 mm.; maximum rainfall in one day, 53 mm.; total evaporation, 2,357.7 mm.; maximum evaporation in one day, 15 mm.; order of frequency of the wind, E., SE., NE., S., NW., N., W., SW. The mean shade temperature for 15 years was 23.9° C.; mean rainfall for 20 years, 921.8 mm.; mean evaporation for 20 years, 2,501.5 mm.; order of frequency of winds during 20 years, E., NE., SE., N., S., NW., SW., W.—O. L. FASSIG.

On hail, R. RUSSELL (*London: 1893, pp. 224, pls. 2*).—This is a valuable compilation of statistics relating to hailstorms and hailstones. The contents of the book are well indicated by the chapter headings: (1) Descriptions of hailstorms and hailstones; (2) observations of temperature, clouds, and winds at great altitudes (balloon ascents); (3) electricity and hail; (4) theories of hail; (5) certain properties of vapor, water, ice, and conditions of the air which may be connected with the formation of hail; (6) summary of characteristics of hailstorms and hailstones; (7) the development of a hailstorm; (8) conclusions.

Appendixes: (A) General weather conditions in certain hailstorms, (B) cold produced by radiation from the upper strata of clouds and fog, (C) dust particles and the form of ice crystals, (D) types of hailstorms, (E) notes on recent thunderstorms and hailstorms, (F) storms of hail and rain produced by mixture of winds.—O. L. FASSIG.

Recent foreign studies of thunderstorms, R. DEC. WARD (*Amer. Met. Jour., 11 (1895), No. 12, pp. 435–441*).—A review of investigations in this line in Switzerland.

The influence of the snow covering on soil and climate, M. WINTER (*Landw. Wochenbl. Schles. Holst., 45 (1895), No. 7, pp. 108, 109*).

Daily weather maps.—The countries which issued weather maps during 1894, the area covered by each (in parenthesis), and the years of publication are: Austria (Europe), eighteenth year of publication; Algeria (Europe and northern Africa), nineteenth year of publication; Belgium (southern, western, and northern Europe), eighteenth year of publication; France (Europe), thirty-eighth year of publication; Germany—Hamburg (Europe), nineteenth year of publication; Germany—Bavaria (Europe), fourteenth year of publication; Germany—Saxony (Europe), seventeenth year of publication; Great Britain (British Isles and western Europe), twenty-seventh year of publication; India (India and Burma), sixteenth year of publication; Italy (southern Europe), sixteenth year of publication; Japan (Japan), twelfth year of publication; Russia (Europe), twenty-third year of publication; Spain (Spain, France, and northern Italy), second year of publication; United States (United States and southern Canada), twenty-fourth year of publication; Switzerland (Europe), fourteenth year of publication.

Most of these maps have been received in the library of the Weather Bureau of this Department.—O. L. FASSIG.

Weather record at Newport (Arkansas) Substation for the season of 1894, G. B. IRBY (*Arkansas Sta. Bul. 31, p. 32*).—A daily record of maximum and minimum temperatures and rainfall for 7 months (April to October).

Meteorological summaries for North Carolina for December, 1894, H. B. Battle, C. F. von Herrmann, and R. Nunn (*North Carolina Sta. Weather Service Bul. 63, pp. 187–200, maps 2*).—The usual summaries of observations of the State Weather Service coöperating with the Weather Bureau of this Department.

Notes on climate of Wyoming, B. C. Buffum (*Wyoming Sta. Rpt. 1894, pp. 36–45*).—A reprint from Bulletin 17 of the station (E. S. R., 6, p. 18).

Observations of the New England Weather Service, 1893 (*Annals of Harvard Coll. Observatory, vol. 41, No. 2, pp. 33–61, pl. 1*).—The usual annual summary of observations from about 200 stations, with general characteristics of the weather, and enumeration of the principal cyclonic disturbances during the year. The following departures from annual normal values during the period 1885–'93 are given:

Departures from annual normals, 1885–'93.

	1885.	1886.	1887.	1888.	1889.	1890.	1891.	1892.	1893.
From the temperature normal (degrees)	−1.3	−0.40	−0.50	−1.80	+1.70	+0.10	+1.4	+0.20	−1.40
From the precipitation normal (in.)	−1.2	+0.93	+2.69	+11.76	+4.25	+4.59	+0.2	−0.48	−0.29

—O. L. FASSIG.

Weather and crops, C. E. Linney (*Illinois State Weather Service (1895), No. 1, pp. 8*).—The central office of the Illinois State Weather Service was recently transferred from Springfield to Chicago, with W. L. Moore in charge. "Weather and Crops" is the title of the official monthly publication of this service. It is a very creditable addition to the numerous State Weather Service monthly reviews.—O. L. FASSIG.

Weather Service in Pennsylvania.—In a communication to the senate and house of representatives of the State of Pennsylvania from the Franklin Institute (6 octavo pages) the value of a State Weather Service is set forth and an appropriation of $6,000 for maintaining such a service is urged.—O. L. FASSIG.

Temperature and rainfall charts for the Dominion of Canada, January, 1895.—The Central Meteorological Office at Toronto has begun the issue of monthly charts, of which this seems to be the first, showing the mean temperature and the difference from the mean average temperature, the total rainfall and snowfall, and the depth of the snow on the ground on the last day of the month. The size of the map is about 24 by 11 in. The region covered is a narrow belt of about 4 degrees, extending from the Atlantic to the Pacific.—O. L. FASSIG.

Central American rainfall, M. W. Harrington (*Phil. Soc. Washington, Bul. 13 (1895), pp. 30, pls. 4*).—This paper deals with the nature and extent of observations recorded; geographic conditions; annual rainfall; distribution during the year; distribution through the day at San José, Costa Rica; and variation of rainfall.

Snow charts of Austria, winter of 1894–'95 (*K. K. Österr. Central Bureau hydrog. Dienst, Wien*).—Charts showing depth of snow on the ground on Saturday of each week in the drainage area of the Danube, with tabular review.—O. L. FASSIG.

Meteorological observations in Würtemberg in 1893 (*Deut. Met. Jahrbuch, 1893, pp. 69, pls. 2*).—This volume contains the records from 100 stations for observing meteorological and phenological phenomena. The establishment of a station of the first order at Hohenheim is described by Prof. Dr. Mack, who also discusses the daily periods of rainfall from observations covering a period of 10 years at this station.—O. L. FASSIG.

Indian meteorological memoirs (*Volume V, parts IV, V, and VI. Calcutta: 1894*).—Volume V treats of the diurnal variation of atmospheric conditions in India, being a discussion of the hourly observations recorded at 25 stations since 1873. Part IV discusses the hourly observations at Allahabad; part V, the observations at Lucknow; part VI, the observations at Agra.—O. L. FASSIG.

Instructions to observers of the India Meteorological Department, J. ELIOT (*Calcutta: 1894, pp. 103, pls. 3*).—This pamphlet of "instructions" is intended to supersede the well-known and excellent "Indian Meteorologist's Vade Mecum" published in 1877, but is much reduced in size and scope. It is confined to a description of the various instruments in use at the meteorological observatories in India, as all reductions of observations are made at the Meteorological Office, Calcutta.—O. L. FASSIG.

Meteorological observations in Italy, 1890 (*Ann. Uff. Cent. Meteorol. Geod. Ital., 12 (1890), II. Roma: 1895, pp. 383*).—Part II of the Annali contains the decade, monthly, and annual means for all stations in Italy under the direction of the national central office. In addition to the ordinary observations the amounts of evaporation are given for 63 stations for each decade.—O. L. FASSIG.

Meteorological observations in Mexico, 1894 (*Obs. Met. Magnét. Central., 1894, Dec. Mexico: pp. 9*).—Summaries for December, with annual means.

Russian Monthly Weather Review, Jan.-Dec., 1894 (*St. Petersburg: 1894*).—The reviews contain the ordinary meteorological observations for about 75 stations in the Russian Empire. Each number comprises 10 large quarto pages of tabular matter, and text (in the Russian language), together with a chart showing the mean monthly pressure and temperature and total rainfall.—O. L. FASSIG.

Meteorological observations in Sweden during 1890 (*Acad. Roy. Sci. Sweden, 32 (1890). Stockholm: 1894, pp. 155*).—The volume is divided into 3 sections. The first contains observations *in extenso* at 18 stations, the second the monthly and annual means of all meteorological elements for 37 stations and of temperature for 93 stations, and the third pentad means for the 37 stations of part 2.—O. L. FASSIG.

WATER—SOILS.

Further investigations on the soils of Maryland, M. WHITNEY and S. KEY (*Maryland Sta. Bul. 29, pp. 153–174*).—A brief discussion of "some of the underlying principles of the relation of soils to crops" more fully treated in the Annual Report of the station for 1891 (E. S. R., 4, p. 17) and Bulletin 21 of the station (E. S. R., 5, p. 162), with a report on physical examinations of typical truck and wheat soils of the Eastern Shore of Maryland; limestone soils of the Cumberland and Frederick Valleys; mountain peach soils (Cambrian sandstone); gneiss soils (corn and wheat) from Bel Air, Darlington, Churchville, and Glenville; and wheat and corn soils of southern Maryland.

Soil temperature observations in Cordova, Argentine Republic (*An. Ofic. Meteorol. Argentina, vol. IX. Buenos Ayres: 1894*).—Observations of temperature in the soil at the surface and at depths of 0.1, 0.25, 0.5, 1.2, 2.7, and 3.75 meters are reported. A summary of results for the year is given in the following table:

Soil temperatures (degrees C.).

	At surface.	0.1 meter.	0.25 meter.	0.5 meter.	1.2 meters.	2.7 meters.	3.75 meters.
Maximum	29.4	25.6	24.2	22.8	21.5	22.0	20.2
Minimum	2.9	5.3	6.8	10.0	13.8	14.9	17.8

—O. L. FASSIG.

Soil temperatures in Bombay, India, 1893 (*Mag. and Met. Observ., Government Observatory, Bombay, 15 (1894), No. 15, pp. 12*).—Soil temperatures are reported for depths of 1, 9, 20, 60, and 132 in. below the surface, the 2 former 5 times daily, the 3 latter once a day at 2 p. m. The maximum and minimum readings were as follows:

Soil temperatures (degrees F.).

	1 inch.	9 inches.	20 inches.	60 inches.	132 inches.
Maximum	85.6 (May)	84.9 (May)	85.8 (June)	85.6 (June)	84.0 (July).
Minimum	74.8 (Feb.)	75.0 (Feb.)	78.0 (Feb.)	80.9 (Feb.)	81.2 (March).

—O. L. FASSIG.

Analyses of drinking water, J. L. HILLS and B. O. WHITE (*Vermont Sta. Rpt. 1893, pp. 22–25*).—Analyses with reference to sanitary condition of 25 samples of spring water, 17 of well water, 7 of pond and aqueduct water, and 10 of Lake Champlain water are tabulated.

Soil temperatures, B. C. BUFFUM (*Wyoming Sta. Rpt. 1894, p. 42*).—A reprint from Bulletin 17 of the station (E. S. R., 6, p. 23).

Investigations on the radiation of heat by the soil, J. AHR (*Forsch. Geb. agr. Phys., 17 (1894), No. 5, p. 397*).

Exhaustion of soil by trees (*Garden and Forest, 8 (1895), pp. 142, 143*).—Quotes a letter from B. E. Fernow on the subject.

The reclamation of arid lands, A. A. JOHNSON (*Wyoming Sta. Rpt. 1894, pp. 47–65*).—A reprint from Bulletin 18 of the station (E. S. R., 6, p. 345).

FERTILIZERS.

The world's consumption of fertilizers—nitrate of soda, MAZIÈRES (*L'Engrais, 10 (1895), Nos. 13, pp. 299, 300; 14, pp. 324, 325*).—The amount and value of nitrate of soda consumed in different countries is stated to be as shown in the following table:

Consumption of nitrate of soda in different countries.

	Amount consumed.					Value in 1894.[1]
	1890.	1891.	1892.	1893.	1894.	
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	
Germany	316,300	368,400	366,800	349,000	397,200	$15,848,280
France	197,900	183,400	175,400	175,700	187,100	7,465.290
England	119,000	124,400	118,800	101,800	117,000	4,668,300
Belgium	91,600	94,600	95,100	100,000	123,700	4,835,630
Holland	47,200	48,500	47,400	53,700	56,700	2,262,330
Italy and Spain	13,800	9,300	8,500	9,000	5,200	207,480
America	103,000	100,000	100,000	104,000	100,000	3,990,000

[1] The value per ton is taken as 210 francs, or $39.90. The French ton contains 2,204.6 lbs.

The influence of the mineralogical composition of rocks on vegetation, F. X. GILLOT (*Bul. Soc. Bot. France, 41 (1894), pp. XVI–XXXVI*).—Investigations are reported which led to the following conclusions: The appearance of certain species of plants usually associated in soil apparently different from that of its ordinary habitat

(heteroptic colonies) depends not only on the presence of sufficient chemical elements in the soil, but also on the combinations and proportion of these elements in the soil and in the minerals from which they are derived, and on the power which the plants possess of utilizing these fertilizing elements.

Recent investigations on the nitric ferment, VOGEL (*Jahrb. deut. Landw. Ges., 9 (1894), pp. 28–30*).—A brief review of the work of Winogradsky, Stutzer, Rubner, A. Müller, and Tacke.

Bones, their manufacture in fertilizers and value in agriculture, BRAUER (*Jahrb. deut. Landw. Ges., 9 (1894), pp. 30–34*).—A popular article.

The utilization of the nitrogen in green manures and in stable manure, J. KÜHN (*Landbote, 16 (1895), No. 18, pp. 155–157; No. 19, pp. 166–169*).—See E. S. R., 6, p. 396.

Gulick's mineral fertilizer, P. COLLIER (*Cult. and Country Gent., 1895, Apr. 4, p. 264*).

Genuineness of basic slag, F. SESTINI (*Staz. Sper. Agr. Ital., 26 (1894), pp. 57–62; abs. in Jour. Chem. Soc. London, 68 (1895), Mar., p. 86*).

The phosphate deposits of North America, WOHLTMANN (*Jahrb. deut. Landw. Ges., 9 (1894), pp. 101–119*).—A brief discussion of character and extent of deposits, composition, market price, and exports of Canada, South Carolina, and Florida phosphates, with remarks on their importance to German agriculture.

Fertilizer experiments of the German Agricultural Society, C. NÖRMER (*Landw. Wochenbl. Schles. Holst., 45 (1895), No. 8, pp. 127, 128*).

Tables for calculating fertilizer analyses, H. B. MCDONNELL ET AL (*Maryland Sta. Bul. 29, Appendix, pp. 16*).—Tables show (1) side by side the per cent of phosphoric acid and tri-calcium phosphate corresponding to the weight of magnesium pyrophosphate calculated for 0.4 gm. substance; (2) phosphoric acid corresponding to weight of magnesium pyrophosphate calculated for 0.4 and 0.5 gm. substance and for each tenth of a milligram; (3) potash, K_2O, corresponding to weight of $KPtCl_6$ calculated for each milligram and for 1 gm. substance; (4) per cent of nitrogen corresponding to each tenth cubic centimeter of one tenth normal solution; (5) per cent of ammonia, NH_3, corresponding to each tenth cubic centimeter of one tenth normal solution; and (6) the value per ton of fertilizers from percentage for prices of 6, 3, and 2 cts. per pound.

Fertilizer analyses of the North Carolina Fertilizer Control, H. B. BATTLE (*North Carolina Sta. Special Buls. 22, pp. 10; 23, pp. 12*).—Tabulated analyses of samples of fertilizers accompanied by the usual explanatory notes.

Fertilizer inspection in Rhode Island, H. J. WHEELER and B. L. HARTWELL (*Rhode Island Sta. Bul. 30, pp. 59–65*).—Tabulated analyses and valuations of 27 samples of fertilizers; a table giving statistics of fertilizer inspection during 1894 and agreement of actual and guaranteed composition; and notes on valuation.

Report of analyses of fertilizers and feeding stuffs made under the act of 1893 (*Jour. [British] Board. Agr., 1 (1895), No. 3, pp. 276, 277*).—Four hundred and forty-four samples were analyzed during 1894, 317 being of fertilizers and 127 of feeding stuffs.

Analyses of fertilizing materials, J. L. HILLS and B. O. WHITE (*Vermont Sta. Rpt. 1893, pp. 21, 22*).—Analyses of 19 samples of wood ashes, 3 of muck, 1 of tankage, and 2 of a mixed fertilizer are tabulated.

Analyses of fertilizers licensed for sale in the State of Vermont in the year 1893, J. L. HILLS (*Vermont Sta. Rpt. 1893, pp. 17–19*).—An abstract of Bulletin 35 of the station (E. S. R., 5, p. 164).

FIELD CROPS.

Alfalfa, how and where to grow it, C. W. IRISH (*pp. 11*).—This pamphlet gives directions for the choice and preparation of the soil, for sowing the seed, and for the management of the crop in semiarid regions, both with and without irrigation. The author states that the seed furnishes a valuable dyestuff and that for this use large quantities of seed are exported from this country to France. Several examples illustrating the depth to which alfalfa roots penetrate, and several instances of a successful catch of alfalfa secured without irrigation on light, sage brush land, by simply harrowing the surface without plowing, are given. On mountain slopes in Nevada it is claimed that the plant withstands extremely low temperatures. Young frosted shoots may induce bloating in animals, as will overfeeding with green alfalfa.

Fertilizer experiments with buckwheat, J. C. CHAPMAN (*Southern Planter, 56 (1895), No. 3, pp. 112, 113*).—This experiment was conducted on a well-worn clay loam soil near Fredericksburg, Virginia. The seed was sown July 25 at the rate of 15 qts. per acre. On account of drought the stand was very thin and the yield was very small. Neither gypsum, air-slacked lime, nor muriate of potash alone increased the yield over that of the unfertilized plats. Indeed, muriate of potash when applied at the rate of 100 lbs. per acre either alone or in combination appeared to reduce the yield. Nitrate of soda and superphosphate applied alone and in combination increased the yield. A complete fertilizer consisting of 120 lbs. of nitrate of soda, 340 lbs. of superphosphate, and 50 lbs. of muriate of potash gave the largest yield.

Analysis of burnet (Poterium sanguisorba), J. HENDRICK (*Rpt. Expts. Manuring, 1893, Glasgow and West Scotland Tech. Col. Glasgow: 1894, pp. 28, 29*).—The dry matter of burnet, cut just as the plant was coming into bloom, had the following composition:

	Per cent.
Nitrogenous matter	25.50
Fat	4.14
Nitrogen-free extract	53.18
Fiber	10.28
Ash	6.90
	100.00

The percentage of total nitrogen in the dry matter was 4.08, and of albuminoid nitrogen 2.78.

Serradella was also analyzed, and the dry matter afforded 3.54 per cent of total nitrogen and 2.01 per cent of albuminoid nitrogen.

Experiments with corn, R. J. REDDING (*Georgia Sta. Bul. 27, pp. 187–195*).

Synopsis.—Tests of fertilizers, of cotton-seed meal and cotton hulls applied together *vs.* cotton seed, variety tests, and an experiment in pulling fodder. All of the fertilizer mixtures caused a financial loss. Cotton-seed meal and hulls proved slightly superior to cotton seed. Fodder pulling yielded a slight net profit, although it reduced the yield by 2.77 bu. of corn per acre.

These experiments are in continuation of those reported in Bulletin 23 of the station (E. S. R., 6, p. 223). The weather conditions for the season are noted, the rainfall being tabulated.

Fertilizer experiments (pp. 188–190).—The basal mixture consisted of 312 lbs. of acid phosphate, 18 lbs. of muriate of potash, and 130 lbs. of nitrate of soda per acre, and cost $6. Every increase in one or more of the ingredients caused a financial loss, as did the basal mixture itself. The conclusions agree with those of previous years that it is not expedient to rely on commercial fertilizers for corn, but that this crop should follow a well-fertilized cotton crop. Nitrogen was the most effective of the 3 fertilizer constituents used.

Cotton-seed meal and hulls vs. cotton seed (pp. 194, 195).—Seven hundred and sixty-four pounds per acre of crushed cotton seed yielded 0.86 bu. of corn less than did the meal and the hulls obtained from the above amount of cotton seed, the quantities of minerals applied being the same with each.

Varieties (pp. 192, 193).—Of 13 varieties tested the largest yield (13.19 bu. per acre) was made by Shaw Improved.

Pulling fodder (pp. 190–192).—Pulling fodder (stripping the blades) reduced the yield of corn 2.77 bu. per acre. The yield of blades was 587 lbs. per acre on fertile land. With corn at 65 cts. per bushel and fodder at 75 cts. per 100 lbs., pulling fodder resulted in a net gain of 92 cts. per acre.

Varieties of corn, J. L. HILLS (*Vermont Sta. Rpt. 1893, pp. 111–114*).—Tabulated data give the characteristics and composition of 13 varieties of corn. The largest yield of dry matter was made by Virginia Horse Tooth, Leaming, and Egyptian Sweet. The dry matter of the Egyptian Sweet corn had a larger nutritive value, pound for pound, than that produced from any other variety.

Field experiments with cotton, R. J. REDDING (*Georgia Sta. Bul. 27, pp. 196–210*).

Synopsis.—These consisted of (1) variety tests, in which Jones Improved gave the largest value of lint and seed; (2) distance experiments, in which the results favored a distance of 1 by 4 ft.; (3) fertilizer experiments; (4) an experiment in plowing under green pea vines, mature pea vines from which the peas had been picked, and pea vine stubble, resulting in favor of making hay of the vines and plowing under the stubble; and (5) a test of Florida phosphate *vs.* superphosphate, resulting in favor of the latter.

These experiments are in continuation of those reported in Bulletin 23 of the station (E. S. R., 6, p. 527).

Test of varieties (pp. 196–200).—Fifteen varieties were tested. The yield at each picking, number of bolls to a pound of seed cotton, number of seeds in 1 lb., yield of lint and seed, per cent of lint, and total value of lint and seed are tabulated. The largest yield of lint (628 lbs. per acre) and also of seed was made by Jones Improved; this variety stood second in size of boll and fourth in earliness.

The small seeded varieties "are better suited to thin or moderately fertilized soils, since they make smaller drafts on the soil; while the larger bolled, larger seeded varieties are perhaps better adapted for high culture, for strong or liberally manured soils."

Distance experiments (pp. 200–202).—In rows 4 ft. apart single stalks were left at distances of 1, 2, 3, and 4 ft. Both on the plats liberally fertilized and on the unfertilized plats the largest yield was made at distances of 1 by 4 feet. The following table gives the yields of seed cotton at each of these distances for each of the years during which the experiment has been in progress:

Yield of seed cotton at different distances.

	4 by 1 ft.	4 by 2 ft.	4 by 3 ft.	4 by 4 ft.
1891	1,943	2,027	2,007	1,883
1892	1,616	1,516	1,501	1,439
1893	1,903	1,905	1,925	1,770
1894	2,065	1,812	1,843	1,671
Averages of 4 years	1,882	1,815	1,819	1,678

The author advises early planting when it is intended to give each stalk ample distance, and close planting as the northern limit of the cotton belt is approached.

Effect of increasing amount of fertilizer (pp. 202–204).—In this experiment a complete fertilizer was applied at the rate of 400, 800, and 1,200 lbs. per acre, and the results were compared with those secured on unfertilized plats. With the variety King the use of 400 lbs. of fertilizer resulted in a profit of 71 per cent on the investment for fertilizers; for the variety Jones Improved, 14 per cent. Using 800 lbs. of fertilizer there was a profit of 11 per cent with King, but a loss of 8 per cent with Jones Improved. Twelve hundred pounds of fertilizer resulted in a financial loss with both varieties.

General fertilizer experiments (pp. 205–207).—In 1894 the formula giving best results consisted of 468 lbs. of acid phosphate, 54.6 lbs. of muriate of potash, and 130 lbs. of nitrate of soda, and the mixture contained 10 per cent available phosphoric acid, 4 per cent potash, and 3 per cent nitrogen. With none of the fertilizer mixtures was there any considerable profit.

Green manuring with cowpeas (pp. 207–209).—Cowpeas planted after oats in 1893 were plowed under (1) green, or (2) after the peas had been picked, or (3) the stubble was plowed under, the vines being made into hay. The results agree with those of previous years in showing that the greatest profit (taking into consideration the value of the cotton crop of 1894 and the value of the cowpeas and hay in 1893) was obtained by making hay of the vines and plowing under the stubble.

Florida soft phosphate vs. superphosphate (pp. 209, 210).—Superphosphate in a complete fertilizer was compared with an equal amount and

with larger amounts of Florida soft phosphate. Superphosphate at $14 per ton proved far superior both in yield and in financial returns to soft phosphate at $12 per ton.

Miscellaneous fodder crops, J. L. HILLS (*Vermont Sta. Rpt. 1893, pp. 114–118*).—The composition and yield per acre of food constituents are tabulated for Japanese radish, spurry, millet, rape, soja bean, horse bean, and sunflowers, and for mixtures of peas, oats, and rape, hairy vetch and soja beans, hairy vetch and horse beans, and vetch, oats, and rape. The largest yield of dry matter, 7,491 lbs. per acre, was made by rape; this plant produced a larger crop when the drills were 6 in. apart than when planted at a distance of 27 in. apart. Japanese radish was refused by cattle; sunflower heads afforded 2,738 lbs. dry matter per acre, containing 607 lbs. of fat, a much larger quantity than that produced by any other crop.

American ginseng, G. V. NASH (*U. S. Dept. Agr., Division of Botany Bul. 16, pp. 22, figs. 2*).—The roots of ginseng (*Panex quinquefolium*) are exported to China, where they are used medicinally. The following topics are treated: History, description, geographical distribution, medicinal properties, commercial value, export statistics, protection against extermination, cultivation, composition, and preparation of ginseng for market.

"There are two ways in which a start may be made in the cultivation of ginseng, viz, by transplanting the wild roots and by sowing seed. By the latter method from 4 to 7 years are required to produce the first crop of marketable roots, and the land yields no income in the meanwhile. The more speedy and better plan is to transplant wild roots of different ages. This is to be done in the fall of the year, the seed of the plants being collected at the same time and sown . . . The following autumn dig up the roots and replant all that are not of marketable size, sowing all the seed yielded by the bed."

A ginseng bed should be shaded, and hence its best location is in a wood from which the underbrush has been removed. It is recommended to plant the seed in drills 2 or 3 in. apart and 1 in. deep at the rate of 1 seed per inch. The seed should be sown as soon as gathered, or if kept for any time it should be packed in moist loam. If allowed to dry it will not germinate. Eighteen months usually elapse between planting and germination. When the plants are 2 or 3 years old they may be again transplanted to carefully prepared beds.

"When the plants are from 4 to 7 years old, they are to be dug up in the fall, after the seed is gathered. They should then be sorted, all that are large enough for the market being taken out and the remainder replanted. In digging the roots great care should be exercised not to mutilate them, as their value is increased in proportion to their freedom from blemishes."

The consumption of ginseng is limited and there is a possibility of glutting the market. On the other hand, its culture requires but little capital, and when the price is low the roots can be left in the ground to await higher prices.

Flax culture, STREHL (*Jahrb. deut. landw. Ges., 9 (1894), pp. 137, 138*).—As the result of 10 years' work the author condemns the use of fresh stable manure on flax. An application of 540 lbs. of kainit and 27 to 54 lbs. of soluble phosphoric acid per acre is recommended. The kainit is applied in the fall, superphosphate before planting in spring. The use of nitrate of soda is not advised, as it may cause the crop to lodge.

Preparation of the soil, as thorough as for beets, is advised. Plowing so deep as to bring to the surface some raw soil is not regarded as injurious. A shallow seed bed is made and the seed is sown as early in the spring as practicable. Directions for harvesting and marketing flax and an estimate of the cost of flax production are given.

Flat pea, F. LAMSON-SCRIBNER (*U. S. Dept. Agr., Division of Botany Circular 4, pp. 7, figs. 2*).—The subjects treated are description, history, uses, cultivation, and rate of growth of the flat pea (*Lathyrus sylvestris*). The author believes more extensive cultivation is necessary before the true value of this plant can be definitely ascertained. It requires soil in which the water is at least 13 ft. below the surface. Its early growth is slow and it is usually not mowed until the third year.

Effect of fertilizers on lupines, DAMSEAUX (*Jour. Ass. Anc. Élèv. Gembloux, 4 (1894), No. 9, pp. 328–330; abs. in Centbl. agr. Chem., 23 (1894), No. 12, pp. 850, 851*).—The yields of yellow lupines, under the influence of different manures, are given in the following table:

Yield per acre of green material of yellow lupines and nitrogen contained therein.

	Yield per acre.	Nitrogen.
	Pounds.	*Pounds.*
No fertilizer	27,097	136
624 lbs. kainit	28,302	142
490 lbs. quicklime	33,008	166
490 lbs. quicklime 624 lbs. kainit	35,006	176
1,070 lbs. Thomas slag	32,076	160
1,070 lbs. Thomas slag 624 lbs. kainit	32,789	164

The yield was considerably increased where quicklime was used, although the yellow lupine does not prefer a strongly calcareous soil.

The unfertilized plat yielded 7,587 lbs. of fresh roots containing 1,517 lbs. of dry matter. The plat fertilized with lime and kainit, though making above ground a much larger yield of green material than the unfertilized plat, afforded only 5,569 lbs. of fresh roots containing 1,114 lbs. of dry matter.

The plants artificially provided with fertilizing materials produced a smaller amount of roots than those which were compelled to obtain their supply entirely from the soil.

Fertilizer experiments on meadows, R. P. WRIGHT (*Rpt. Expts. Manuring, 1893, Glasgow and West Scotland Tech. Col. Glasgow: 1894,*

pp. 13–26).—These experiments were conducted in the favorable season of 1893 on 12 farms in the southwestern part of Scotland. In estimating profits only the first cutting or main crop of hay was considered. Were the value of the aftermath included, all fertilizers would show a profit.

Salt was applied early in May at the rate of 768 lbs. per acre, and as no rainfall followed the salt scorched the vegetation. However, the deep-rooted and valuable forage plants on most farms recovered from this injury, while the shallow-rooted weeds, especially the yellow rattle (*Rhinanthus crista-galli*) and *Holcus lanatus*, were to a considerable extent eradicated by the application of salt. This killing of weeds improved the quality of the hay on the plats receiving salt. Salt was more uniformly effective in augmenting the yield of timothy than of mixtures of other grasses and clover.

Nitrate of potash alone, at the rate of 224 lbs. per acre, increased the yield of hay, especially on the plats where there were some clover plants.

Potash in the form of muriate and kainit proved of practically equal value.

Muriate of potash, 224 lbs., and nitrate of soda, 208 lbs. per acre, in combination, largely increased the yield of hay and was profitable. With the addition to this of 312 lbs. of nitrate of potash the yield of hay very largely increased, especially on the timothy plat, the average increase being one fifth of a ton per acre.

Superphosphate gave variable results on different farms and on different species of grasses; on clover its action was especially favorable, but on the average its application to grass was not profitable. Non-nitrogenous mixed minerals proved beneficial on clover, but only slightly effective on grasses. Nitrate of soda alone and in combination resulted in a large and profitable increase in the yield of hay. In every case a complete fertilizer returned a profit.

In a grazing experiment cattle showed a preference for the grasses growing on the plats fertilized with nitrates, either alone or in combination.

Effect of fertilizers on the composition of hay, J. HENDRICK, (*Rpt. Expts. Manuring, 1893, Glasgow and West Scotland Tech. Col. Glasgow: 1894, pp. 27, 28*).—The author's analyses controvert the view sometimes expressed that the hay made from grasses fertilized with nitrates is of inferior nutritive value on account of its large proportion of non-albuminoid nitrogen. The plat receiving a complete fertilizer, in which the nitrogen was in the form of nitrate of soda, yielded hay richer both in total and in albuminoid nitrogen than that from any other fertilized plat.

When potash was applied alone the percentage of total nitrogen was small, but a large proportion of this was in the form of albuminoids.

Fertilizer experiments on oats, R. P. WRIGHT (*Rpt. Expts. Manuring, 1893, Glasgow and West Scotland Tech. Col. Glasgow: 1894, pp. 53–57*).—Commercial fertilizers were in most cases used with profit on the oat crop in the favorable season of 1893. Nitrate of soda applied alone was profitable as a top dressing on soils already in good condition, but on poor land the results were variable. When superphosphate was added to the nitrate of soda the result was more certain and profitable. A complete fertilizer was advantageously used on the oat crop following sod, but potash was not profitable when the preceding crop had been roots liberally fertilized with barnyard manure. Nitrate of soda was somewhat more effective than sulphate of ammonia, especially in the production of straw.

Peanuts, R. L. BENNETT and G. B. IRBY (*Arkansas Sta. Bul. 31, pp. 19–23*).—Two varieties grown at the station and at the two substations averaged 73 bu. per acre of selected nuts. The Spanish variety contained in every 100 lbs. of unshelled nuts 79 lbs. of kernels; the Virginia variety only 61 lbs. The Spanish is preferred as a food for hogs. Directions for the cultivation of peanuts are given.

Potatoes, a simple test of quality, E. S. GOFF (*Rural New Yorker, 1895, Apr. 6, p. 241*).—When potatoes are placed for a few minutes in brine the lightest or those of poorest quality and most deficient in starch rise to the top. By this method it is an easy matter with the aid of a hydrometer to determine the amount of starch and hence the quality of the potatoes.

The author planted the light, the medium, and the heavy potatoes as indicated by the brine test for 2 years in succession, and unlike European investigators, noted no improvement in the quality of the crops as a result of this selection. He found that tubers growing nearest the surface were of lowest specific gravity or poorest quality, and that the specific gravity increased with the depth at which the potato grew. This he ascribes to the cooler temperature found at greater depths. He also found that potatoes grown in level culture, with the consequent lower temperature within the soil, had a greater specific gravity than those grown in hills.

Giant knotweed or sachaline, F. LAMSON-SCRIBNER (*U. S. Dept. Agr., Division of Botany Circular 5, pp. 4, figs. 3*).—This circular treats of the general characters and history of sachaline (*Polygonum sachalinense*), its probable value as a forage plant and as a protection for river banks, and methods of propagating it. The general cultivation of this plant is not recommended.

Fertilizer experiments on turnips, R. P. WRIGHT (*Rpt. Expts. Manuring, 1893, Glasgow and West of Scotland Tech. Col. Glasgow: 1894, pp. 11, 12, 35–52*).—This experiment was conducted on 16 farms. Large and profitable crops of turnips were grown by the use of mixtures of commercial fertilizers without any farm manures. Phosphoric acid was the most effective fertilizing constituent applied. In the

form of superphosphate it was in most cases more valuable than in slag and bone meal. However, on peaty or mossy soils slag was equally effective. Bone meal gave a smaller increase in the yield of turnips than basic slag and nitrate of soda applied together in such quantities as to furnish equivalent amounts of phosphoric acid and nitrogen. Sulphate of potash proved a profitable addition to phosphatic and nitrogenous fertilizers. Barnyard manure alone afforded large crops, but better results were obtained by using half rations (10 tons per acre) of barnyard manure with small quantities of phosphatic and nitrogenous fertilizers.

The soil of the unfertilized plat on one of the farms contained 0.126 per cent of phosphoric acid and 0.116 per cent of potash. The amounts soluble in a 1 per cent solution of citric acid were 0.0054 per cent of phosphoric acid and 0.0062 per cent of potash. This soil responded freely to phosphatic and potash fertilizers, as also to nitrogen. As compared with the unfertilized plat there was an increased yield of 13 tons per acre when a high grade superphosphate was applied, 14 tons when superphosphate and nitrate of soda were used, and 19 tons when superphosphate, nitrate of soda, and sulphate of potash were applied.

Jerusalem artichokes, turnips, and mangel-wurzels, R. L. BENNETT and G. B. IRBY (*Arkansas Sta. Bul. 31, pp. 24–28*).—These crops were grown as food for hogs. At Newport Jerusalem artichokes were planted 36 by 18 in. apart and the yield was 453¾ bu. per acre; at Fayetteville the distance was 3 by 3 ft. and the yield 612 bu. per acre. Nineteen varieties of turnips were grown. The test of mangel-wurzels was unsatisfactory. Food analyses of artichokes, sweet potatoes, mangel-wurzels, and turnips are given.

Experiments at Borsbeke-lez-Alost (Belgium), P. DE VUYST (*Rev. Agron. Louvain, 3 (1894), No. 4, pp. 251–286*).—These consisted of fertilizer experiments and variety tests on potatoes, oats, carrots, parsnips, and turnips, and culture experiments with potatoes, maize, and roots.

In experiments with beets, wheat, and potatoes the plats submitted to an electric current produced by a zinc and copper couple afforded smaller yields than the check plats. With potatoes the application of nitrate of soda at planting time and during cultivation gave practically the same results. The continued selection of seed potatoes during 3 years by planting those which had the highest percentage of starch, as shown by their sinking in brine, increased the yield 6.5 per cent and raised the percentage of starch in the crop.

On beets the nitrogen of nitrate of soda was more effective than that of sulphate of ammonia. Nitric nitrogen applied at planting afforded a larger yield than an intercultural application. Kainit was of less value on carrots than on parsnips.

Fertilizer experiments with cereals and potatoes at the Swedish Agricultural College, 1892–'93, S. RHODIN (*Kgl. Landt. Akad.*

Handl. Tidskr., 33 (1894), pp. 297–312, 372–384).—Nitrate of soda vs. fish guano for spring wheat and for oats.—The following are the average yields with the different applications of fertilizers:

Yield of wheat and oats with nitrate of soda and fish guano.

Fertilizer.	Nitrogen per hectare.	Time of application of fertilizers.	Yield per hectare. Grain.	Yield per hectare. Straw.
Spring wheat.	*Kg.*		*Kg.*	*Kg.*
Nothing	0		2,451.0	4,742.0
Nitrate of soda	50.00	At sowing time	2,780.5	6,330.0
Do	50.00	At germination	2,953.7	5,796.2
Do	50.00	½ at germination ½ at heading	3,025.0	4,912.5
Fish guano	33.75	Preceding fall	2,641.0	5,508.0
Do	50.00	do	2,643.7	5,218.7
Oats.				
Nothing	0		2,608.5	4,888.0
Nitrate of soda	33.75	At sowing time	3,137.5	5,833.0
Do	33.75	At germination	2,923.5	5,633.0
Do	33.75	½ at germination ½ at heading	2,731.5	5,810.0
Fish guano	33.75	Preceding fall	2,808.3	5,045.0
Do	50.00	do	2,833.3	5,223.0

The best time for applying nitrate of soda to spring wheat was at the time of germination or half at this time and half when the wheat was heading. In case of the oats, on the other hand, the best results were obtained by applying the fertilizer at time of sowing.

Barnyard manure vs. poudrette for winter wheat and other crops.—Beginning in 1891 straw-litter manure and peat-litter manure were compared with peat poudrette as fertilizers for winter wheat. In 1892 ruta-bagas were planted on plats 148.5 square meters in area, the barnyard manure being applied at the rate of approximately 40,000 kg. per hectare, and the poudrette at the rate of 15,000 kg. The poudrette used contained 74.70 per cent of water, 0.86 per cent of nitrogen, 0.45 per cent of phosphoric acid, and 0.44 per cent of potash. The yield of ruta-bagas per hectare was:

	Kilograms.
With straw-litter manure	41,073
With peat-litter manure	43,875
With peat poudrette	43,807

The yield was smallest with straw-litter manure, as it was also in 1891. The residual effect of the 3 kinds of manure was studied during 1893, barley being sown without fertilizers on the plats used in the preceding year's experiments. The yield of barley per hectare was as follows:

Residual effect of manures on yield per acre of barley.

Kind of fertilizer applied to the preceding crop.	Grain.	Straw.
	Kg.	*Kg.*
Straw-litter manure	3,663	5.855
Peat-litter manure	3,880	5,788
Peat poudrette	3,930	5,883

The results of 3 years' experiments show that even for heavy clay the peat-litter manure is superior to straw-litter manure.

Poudrette and nitrate of soda for various crops.—The effect of 3 kinds of poudrette on the yields of hay and of potatoes and on the starch content of the latter was studied in 1892 and 1893. The composition of the poudrette applied was as follows:

Analyses of poudrette.

	Water.	Total nitrogen.	Phosphoric acid.	Potash.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Peat poudrette	70.70	0.86	0.40	0.44
"Riddersirk" poudrette	77.25	1.10	.74	.40
"Concentrated peat poudrette"	49.57	1.68	2.04	1.51

Only "Riddersirk" poudrette increased the yield of hay sufficiently to be profitable.

In 1893 the different kinds of poudrettes and nitrate of soda were compared on potatoes. As in 1892, like money values of the different fertilizers were applied. The soil was a sandy clay. The fertilizers were applied directly before planting the potatoes. The results follow:

Starch content and yield of potatoes.

Fertilizer.	Starch content.	Yield per hectare.	
		Tubers.	Starch.
	Per cent.	*Kg.*	*Kg.*
None	13.43	21,800	2,918
Peat poudrette	13.60	24,025	3,255
"Riddersirk" poudrette	13.66	24,650	3,360
"Concentrated peat poudrette"	13.80	21,000	2,905
Nitrate of soda	11.50	20,925	2,406

The low percentages of starch obtained are explained by the lack of rain in the early vegetation period, the low summer temperature, and the lack of heat and light during the month of September.

The decrease in the starch content of the potatoes receiving nitrate of soda is contrary to the experience of Stutzer, who states that the quality of potatoes is not appreciably lowered by applications of this fertilizer, and that the increase in yield is large, especially in dry seasons.

The effect of peat poudrette and nitrate of soda on barley was studied during 1893, equal money values of both fertilizers being applied. Every plat received Thomas slag at the rate of 80 kg. per hectare. The average results obtained were as follows:

Yield of barley with peat poudrette and nitrate of soda.

Fertilizer.	Yield per hectare.	
	Grain.	Straw and chaff.
	Kg.	*Kg.*
No nitrogenous fertilizer	2,433.0	6,176.5
Peat poudrette, spring 1893	3,139.0	8,037.0
Peat poudrette, fall 1892	2,627.0	6,742.5
Nitrate of soda	3,429.0	8,768.5

Phosphatic slag for potatoes.—The effect of 3 kinds of phosphatic slag on potatoes was investigated during 1893. "Finshytte" slag is made from ferruginous Gellivara apatite and is named after the place of manufacture. Martin's slag is obtained by treatment of Gellivara iron ore in the Martin process. These 2 slags contained 10.94 per cent and 17.83 per cent of phosphoric acid, respectively, while the Thomas slag applied contained 18.54 per cent of this ingredient. The plats were fertilized in the fall of 1892 at the rate of 100 kg. of potash per acre, in the form of sulphate, and 120 kg. of phosphoric acid in the different phosphatic slags; 2 plats received only potassium sulphate.

The average results for the duplicate plats were as follows:

The starch content and yield of potatoes.

Fertilizer per hectare.	Starch content.	Yield per hectare.	
		Tubers.	Starch.
	Per cent.	*Kg.*	*Kg.*
100 kg. sulphate of potash	13.1	10,941	1,433.27
100 kg. sulphate of potash 120 kg. phosphoric acid in Thomas slag	12.8	13,815	1,768.32
100 kg. sulphate of potash 120 kg. phosphoric acid in Martin's slag	12.5	14,648	1,831.00
100 kg. sulphate of potash 120 kg. phosphoric acid in Finshytte slag	11.9	11,471	1,365.04

Lemström's frost torches (E. S. R., 5, pp. 660–662) were used with marked success in the preceding experiments for preventing frost on the potatoes during several nights in the month of August. In the opinion of the author the Lemström peat frost torches are the most convenient, effective, and inexpensive combustive material for the generation of smoke as a preventive of damage from frost. The expense of torches is exceedingly small compared with the value of the crops in danger. Less than 100 torches are required per acre of land, the cost of which in the European market is given as 64 cts.—F. W. WOLL.

Rotation of crops, J. B. LAWES and J. H. GILBERT (*Jour. Roy. Agr. Soc. England, 3d ser., 5 (1894), No. 20, pp. 585–646*).—This is a comprehensive discussion of the results of rotation experiments at Rothamsted, England, begun in 1848. The four-course rotation consisted of (1) Swedish turnips (ruta-bagas), (2) barley, (3) clover (or

beans) or bare fallow, and (4) wheat. One section of the field has received no fertilizers since the experiments began. On the other two sections fertilizers were applied only to the root crop, hence only once in 4 years. In the second section minerals only were used, superphosphate alone being applied in the first 9 courses (36 years), supplemented in succeeding courses by salts of potash, soda, and magnesia. The third section of the field received a complete fertilizer, supplying, in addition to minerals, 140 lbs. of nitrogen every fourth year, equivalent to an average annual application of 35 lbs. per acre. This complete fertilizer consisted of superphosphate, salts of potash, soda, and magnesia, and rape cake.

In each section the turnips on half the area devoted to this crop were fed on the land; on the other half both roots and leaves were permanently removed.

Crop yields under different conditions.—The turnip crop, sometimes regarded as a restorative crop, gave practically no yield without fertilizers. Superphosphate largely increased the yield, a result regarded as largely due to its increasing the growth of feeding roots in the surface soil, and thus enabling the turnip crop to quite completely exhaust the nitrogen previously accumulated in the soil. Hence soil fertility is very rapidly exhausted by growing and removing a turnip crop fertilized with superphosphate alone.

The addition of nitrogen to the mineral fertilizer practically doubled the yield obtained from superphosphate.

On the unmanured section the crop of turnips was so small that it mattered little, as shown by subsequent crops, whether it was removed or retained. On the section treated with superphosphate, feeding turnips on the land increased the yield, and the advantage of this practice was still more marked on the more productive area supplied with a complete fertilizer. The yield of turnips was practically identical whether the field was fallowed or in a leguminous crop 2 years previous.

Barley, the second crop of the course, suffered less from the absence of fertilizers than did turnips, the average yield of the unfertilized section being more than 30 bu. per acre. This was attributed to the thorough preparation for barley, viz, the clean cultivation of turnips, and to the slight draft made on the soil by the small (unfertilized) turnip crop. Naturally the removal or retention of the small turnip crop did not affect the yield of barley. On the plats on which turnips treated with superphosphate had yielded fairly well, the feeding of the turnips on the land considerably increased the yield of barley. However, on the section thus manured the removal of the turnip crop so far exhausted the soil as to reduce the yield of barley below the yield on the unfertilized section. A complete fertilizer applied to the preceding turnip crop largely increased the yield of barley, especially on the plats on which the heavy turnip crop had been fed.

Clover was intended to be the third crop of every course, but repeated failures of this crop led to the frequent substitution of beans in its stead. Thus in the 11 courses clover was grown only 4 times, beans 7 times. The yield of clover without manure averaged 3,000 lbs. per acre, which amount was doubled by superphosphate or mixed minerals, and raised to 6,800 lbs. when a complete fertilizer was applied to the turnip crop 2 years previous. The action of these fertilizers on beans was somewhat similar. Both beans and clover yielded better on plats where the turnip crop grown 2 years before had been fed on the land than on the plats whence it had been removed.

Both mixed minerals and a complete fertilizer applied to turnips increased the yield of wheat in the fourth year after the application. The retention of the turnips somewhat increased the yield of wheat in the fourth year thereafter.

On the unfertilized section and on that which had received minerals alone, on both of which there was soil exhaustion, especially of nitrogen, the wheat crop was somewhat larger after bare fallow than after the leguminous crop which had been removed. On the other hand, the section kept in a high state of fertility by the application of a complete fertilizer to turnips, and thus capacitated for a luxuriant growth of beans or clover (having a heavy crop residue), afforded larger returns in wheat when this latter crop followed a leguminous crop than when it was preceded by bare fallow. Thus on fertile soil the advantage of growing a leguminous crop instead of fallowing consisted not only in the value of the leguminous crop, but also in a slight increase in the wheat crop. Subsequent turnip crops showed no marked difference between the plats fallowed or bearing a leguminous crop 2 years previous.

Amounts of dry matter contained in the crops.—The amount of dry matter, nitrogen, ash, phosphoric acid, and potash in turnips, barley, clover and beans, and wheat, in rotation and in continuous culture, are tabulated and discussed.

The dry matter in turnips grown without fertilizer was practically identical in rotation and in continuous culture, due to the failure of the unfertilized crop grown under both conditions. When fertilized, the turnip yielded more in rotation than in continuous culture.

On the unfertilized section the grain and straw of barley grown continuously contained only about three fifths as much dry matter as in rotation, and on the mixed mineral section considerably less than in rotation. Especially marked was the difference in favor of rotation on the area where turnips had been fed. On the section supplied with a complete fertilizer continuous culture gave best results when the turnip crop of the rotation was removed, but rotation excelled when the turnips were fed.

Under all conditions of manuring beans grown continuously yielded only about half as much as when grown in rotation. A similar com-

parison could not be made for clover, because the crop failed so frequently.

In the wheat crop the dry matter obtained by continuous culture was, on the unfertilized section and on that receiving superphosphate alone, less than half as much, and on the section treated with a complete fertilizer, considerably less than that secured in rotation.

Amounts of nitrogen contained in the crops.—Only an inconsiderable amount of nitrogen was contained in turnips not fertilized. The amount was increased twofold to fourfold under the influence of phosphatic fertilizers alone, which induced the growth of numerous fibrous feeding roots. With a complete fertilizer the amount of nitrogen in the crop was greatly increased in both systems of culture. The large turnip crops obtained by the aid of nitrogenous manures on land which for about fifty years had received no carbonaceous application indicates that the atmosphere is "the chief, if not the exclusive, source of the carbon of the crops."

The nitrogen taken up by barley on the superphosphate section and on the unfertilized plat was considerably greater in rotation than in continuous culture. With a complete fertilizer barley in rotation took up less nitrogen on the plats from which the turnip crop had been removed than in continuous culture. Under all conditions of manuring, about 75 per cent of the nitrogen of the barley crop was contained in the grain.

Beans in rotation took up more than twice as much nitrogen as in continuous culture. In rotation the amounts were 36 lbs. per acre per annum on the unfertilized section, 40 to 50 lbs. with superphosphate, and 63.6 to 70.2 lbs. with a complete fertilizer. Under all conditions clover took up much more nitrogen than beans—without manure, 47 to 55 lbs.; with superphosphate alone, 124.5 to 144.6 lbs.; with a complete fertilizer 167 to 168.4 lbs. per acre. Of the nitrogen in the bean crop (beans and straw) at least 75 per cent was in the beans.

Wheat under all conditions of fertilization utilized more nitrogen in rotation than in continuous culture. Continuous culture gave more nearly equal results when a complete fertilizer was employed. Under all conditions the grain stored up more than twice as much nitrogen as the straw.

Amounts of phosphoric acid in the crops.—Only about half as much phosphoric acid was taken up by the turnip crop in continuous culture as in rotation, due to the unfavorable mechanical effects of the former system by which the total crop was reduced. In rotation and when well fertilized, 5 to 6 times as much phosphoric acid was accumulated in the roots as in the leaves.

Without fertilizers and also with superphosphate, barley took up much more phosphoric acid in rotation than in continuous culture; with a complete fertilizer the two systems of culture gave equal results when turnips were fed on the land, but when removed the rotation crops stored up less phosphoric acid than those under continuous culture.

Clover and beans under all conditions of manuring took up much more phosphoric acid in rotation than in continuous culture. Without fertilizers clover utilized but little more of this ingredient than beans; with superphosphate more than twice as much; and with a complete fertilizer still more. The draft of phosphoric acid was less with the leguminous crops than with the cereals.

Wheat, like barley, took up more phosphoric acid in rotation than in continuous culture. Without fertilizers and also with superphosphates about four fifths of this ingredient was stored in the grain. However, with a complete fertilizer, inducing luxuriant growth, the grain contained only about half the phosphoric acid, the rest being stored in the straw.

Amounts of potash in the crops.—The authors have shown elsewhere that root crops are essentially sugar crops, and that the presence of considerable potash is an important condition in the formation within plants of carbohydrates and especially of sugar. Most of the potash of the turnip crop was found in the roots and this proportion increased with the yield of the crop, the bulk of the potash and sugar being stored in the same part of the plant.

In turnip roots and leaves on the rotation plats, unfertilized, the amount of potash per acre was 4 to 6 lbs.; on the superphosphate plat 25 to 28 lbs., due to the increased feeding capacity resulting from phosphatic fertilizer; and on the area receiving a complete fertilizer 80 lbs. Less potash was utilized in continuous culture than in rotation.

In barley the greater portion of the potash was found in the straw. The amount of potash in the straw was subject to great fluctuations, depending on the supply in the soil and fertilizer, while that in the grain bore a fairly uniform relation to the dry matter.

Without fertilizers and with superphosphate the amounts of potash in the barley crop were not widely different, but with a complete fertilizer the quantity was largely increased. With a complete fertilizer and on a rotation plat from which the root crop had not been removed, the potash in rotation and in continuous culture crops was practically identical.

Beans took up about twice as much potash in rotation as in continuous culture. Without fertilizer and with superphosphate alone the quantaties of potash were practically the same, but with a complete fertilizer these amounts were doubled. Compared with beans grown under parallel conditions clover utilized much more potash; without fertilization, 3 times as much (30 lbs. per acre); with superphosphate alone, more than 5 times as much (57.6 to 65.5 lbs. per acre); and with a complete fertilizer, also more than 5 times as much (123.1 to 132.6 lbs. per acre).

The beneficial effect on clover of superphosphate used alone appeared to be closely connected with the increased capacity thereby conferred on clover of taking up larger quantities of the potash of the soil. In beans more than two thirds of the total potash was found in the seed.

Wheat in rotation took up much more potash than in continuous culture. As with barley, the greater part of the potash was found in the straw, which also contained the bulk of the carbohydrates in the form of cellulose.

The conclusion that phosphoric acid is specially concerned in the formation of the nitrogenous bodies and that potash is likewise related to the non-nitrogenous compounds, though regarded as well founded by the authors, offers only an imperfect explanation of the functions of these mineral constitutents.

Of all the crops of the four-course rotation the leguminous crops take up the most lime, clover sometimes utilizing more than all the other crops of the rotation taken collectively.

Experiments with varieties of barley, N. WESTERMEIER (*Deut. landw. Presse, 22 (1895), No. 22, pp. 198, 199*).

Coffee cultivation at the Gold Coast (Africa) (*Kew Misc. Bul. 98, 1895, pp. 21–23*).

Cotton, R. L. BENNETT and G. B. IRBY (*Arkansas Sta. Bul. 31, pp. 23, 24*).—Brief general statements are made as to Egyptian varieties, crosses of American and Egyptian varieties, and American varieties.

Cowpeas, R. L. BENNETT and G. B. IRBY (*Arkansas Sta. Bul. 31, pp. 11–16*).—Notes on 7 varieties and directions for cultivation are given. The Unknown pea is regarded as the best variety for green manuring and as superior to any of the running varieties for hay. Late planting afforded a growth of vines more nearly upright and a larger yield of peas than early planting.

Lathyrus fodder (*Kew Misc. Bul. 94, pp. 349–353*).

The flat pea (Lathyrus sylvestris), J. SAMEK (*Tirol. landw. Blätter, 14 (1895), No. 1, pp. 1–3*).

The care of meadows, ANDREÆ (*Ztschr. landw. Ver. Hessen, 1895, No. 11, pp. 82, 83*).

Fertilizer experiments on meadows (*Landbote, 16 (1895), No. 6, pp. 41, 42*).

Experiments with varieties of oats and potatoes and experiments in liming the soil, J. NEUMANN (*Landw. Wochenbl. Schles. Holst., 45 (1895), No. 3, pp. 41–43*).

Experiments with varieties of potatoes, C. VIBRAUS (*Deut. landw. Presse, 22 (1895), No. 21, pp. 189, 190*).

Experiments with varieties of potatoes (*Chron. Agr. Canton Vaud, 8 (1895), No. 5, pp. 106–111; No. 6, pp. 138–141*).

A test for the quality of potatoes, L. R. TAFT (*Garden and Forest, 8 (1895), pp. 155, 156*).

The sorghums for forage and grain, F. C. BURTIS (*Rpt. Kans. Bd. Agr., 1895, Mar. 31, pp. 159–166*).

Sugar beets in 1893, E. E. SLOSSON (*Wyoming Sta. Rpt. 1894, pp. 16–23*).—A reprint from Bulletin 17 of the station (E. S. R., 6, p. 38).

Experiments with varieties of spring wheat, WESTERMEIER (*Deut. landw. Presse, 22 (1895), No. 25, p. 233*).

Cost and profit of growing wheat, B. C. BUFFUM (*Wyoming Sta. Rpt. 1894, pp. 14, 15*).—A reprint from Bulletin 17 of the station (E. S. R., 6, p. 44).

On the decortication of wheat, BALLAND (*Compt. Rend., 120 (1895), No. 11, pp. 638–640*).

Industrial plants (Les plantes industrielles, IV), G. HEUZÈ (*Paris*).—This volume is chiefly occupied with tobacco and other narcotic plants, sugar-producing plants, gum-producing plants, medicinal plants, and tea and coffee.

Crop report for 1893, B. C. BUFFUM (*Wyoming Sta. Rpt. 1894, pp. 3–13*).—A reprint from Bulletin 17 of the station (E. S. R., 6, p. 44).

The system and methods practiced at the station farm, R. J. REDDING (*Georgia Sta. Bul. 27, pp. 211–215*).—This is a general statement of the methods of rotation, fertilization, planting, and cultivation practiced on the station farm.

HORTICULTURE.

Tests of plums, apricots, and Japanese persimmons, R. H. PRICE (*Texas Sta. Bul. 32, pp. 473–496, figs. 13*).—This bulletin is chiefly devoted to comparative investigations as to the value of different varieties of plums in Texas. The varieties are arranged according to the natural classification of the species from which they have originated. Descriptive notes are given for 19 varieties of the Chickasaw group (*Prunus angustifolia*), 8 of the Wild Goose group (*P. hortulana*), 5 of the American group (*P. americana*), 9 of the European varieties (*P. domestica*), and 17 of the Japan group (*P. triflora*). In addition 8 unclassified varieties were tested, as were also *Prunus pissardii*, *P. simonii*, and the Utah hybrid dwarf cherry. Over 20 varieties of plums are stated to have originated in Texas, most of them belonging to the Chickasaw group, which succeeds better in the State than the Wild Goose or American groups of varieties, being more productive and freer from insect and fungus injuries. The following varieties are recommended: Caddo Chief, Lone Star, Marianna, Munson, Newman, Paris Belle, Robinson, and Transparent. The European varieties were not satisfactory, but the Japanese plums proved successful, although requiring spraying. Of them Abundance, Burbank, Douglas, Georgeson, Kelsey, and Norman are regarded as promising.

A table is given showing the dates of blooming and ripening of 67 varieties. Experiments were made with the Marianna plum to ascertain its value as a stock for budding, and several nurserymen were questioned in regard to this point. The conclusion arrived at is that the Marianna does not do well as a stock for all varieties, especially on dry uplands.

Brief notes are given on the curculio (*Conotrachelus nenuphar*) and leaf-footed bug (*Leptoglossus phyllopus*), and on the leaf blight, brown rot, and shot-hole fungus. Spraying the trees with 3 oz. of London purple mixed with 25 gal. of Bordeaux mixture is believed to prevent injury by nearly all injurious insects and fungus diseases.

Varieties of 2 species of apricots were tested, 4 varieties of the Chinese or Japanese apricot (*Prunus mume*) and 8 of the common and Russian apricots (*P. armeniaca*) being grown. Myer Early and Royal were most promising.

Ten varieties of the Japanese persimmon (*Diospyros kaki*) were tested, and Hachiya, Tane-Nashi, and Zengi are recommended.

The quince in western New York, L. H. BAILEY (*New York Cornell Sta. Bul. 80, pp. 609–631*).

Synopsis.—General and more detailed directions for the care of quince orchards, with remarks on the choicer varieties and notes on insect and fungus enemies.

This bulletin deals with the quince industry in general and particularly in western New York, where the fruit is more extensively grown than elsewhere. Some of the large and successful orchards in the

State are mentioned and compared with others where careless cultivation makes the crop almost a failure. A heavy, moist clay loam, rendered friable by good cultivation, fertilizing, and draining, is considered to be the best soil for quinces, although they thrive upon lighter lands, where, however, they are shorter lived. In the way of fertilizers, 200 to 300 lbs. of muriate of potash per acre, applied broadcast and harrowed in, is advised, supplemented by 200 to 500 lbs. per acre of phosphoric acid in bone compounds or dissolved South Carolina rock. It is believed that the requisite nitrogen can be supplied by tillage, green manures, and barnyard manure. The common idea that salt is an indispensable quince fertilizer is believed to be erroneous.

Clean culture is strongly urged, and illustrations are given showing the difference in appearance between orchards allowed to run to sod and others where the ground is kept well stirred by shallow tillage. It is advised that sodded orchards be broken up by thorough harrowing in the spring.

Quinces are propagated by cuttings, stooling, apple-root grafting, and budding on quince stocks. Both of the latter methods are recommended, though budding seems to be preferred, the stock being the Angers quince imported from Europe. It is advised that quinces be planted 15 ft. apart each way to allow a sufficient growth to the trees and permit spraying. The top should be started 20 in. or less above the ground and the branches allowed to spread rapidly. Each winter it is recommended to shorten in the annual growth. By this means the fruit is thinned, for the terminal blooms are removed and the crop is borne on the side spurs, being also less liable to injury from winds.

Quince trees begin to bear when 5 or 6 years old and reach their full productiveness when 9 or 10 years planted. An average crop is 1 bu. of good fruit to a tree, but this yield may be even doubled occasionally. Care in picking and packing the crop is urged to avoid bruising and to secure a better appearance of the product.

The 4 leading varieties are Orange, Champion, Rea, and Meech, of which Orange is the most widely known and grown, although Champion has proved the most productive. Illustrated descriptions are given of these varieties. The Chinese or Hong Kong quince (*Pyrus cathayensis*) is mentioned, the fruit being large, often exceeding 2 lbs.

Descriptive notes and treatment are given for leaf blight and spot (*Entomosporium maculatum*), rust (*Rœstelia aurantiaca*), pear blight or fire blight, borer, codling moth, and quince curculio. For the first 2 diseases spraying with Bordeaux mixture is recommended, and experiments are cited showing its beneficial result. Pear blight is regarded as the most serious disease, and can only be treated by cutting off and burning all affected limbs. Digging out the borers, spraying for the codling moth with Paris green, and jarring the curculios on to sheets is advised.

Experiments with fruits and fruit trees, E. S. RICHMAN (*Utah Sta. Bul. 37, pp. 1–10*).—Descriptive notes on various varieties of strawberries, grapes, peaches, apricots, cherries, plums, pears, and apples grown on the station grounds. Notes are given on 14 varieties of strawberries, and Parker Earle, Sharpless, and Thompson No. 7 are recommended. Of the 17 varieties of grapes mentioned Concord, Delaware, Early Victor, and Massasoit are especially advised for planting in Utah. Thirteen varieties of peaches were tested, of which 5 proved to be too late. The early varieties, such as Early Rivers and Early St. John are recommended. The Russian apricots, of which 3 varieties were grown, proved constant and heavy bearers, but produced small fruit, and consequently are not considered so desirable as other larger varieties. On account of their hardiness, however, they are preferred to the larger tenderer varieties of the common apricot. Twelve varieties of cherries were grown, and the sour cherries, such as Mt. Large and Early Richmond, were found to thrive better than sweet cherries, which were not perfectly hardy.

Brief remarks are made on an experiment in giving young orchards different kinds of treatment, alfalfa, clover, timothy, and a mixture of timothy and clover being sown on 4 different plats. As a result after 3 years of this treatment the majority of the trees are dead, while check trees planted on well cultivated land are living and doing well.

Varieties of the strawberry, L. H. BAILEY (*New York Cornell Sta. Bul. 79, pp. 583–600, figs. 9, pl. 1*).—This bulletin consists of a tabulation of the replies received from 110 correspondents throughout the State in regard to the different varieties grown in their sections. The Wilson strawberry still appears to be the leading variety for general cultivation, followed by Crescent, Bubach, Haverland, Warfield, and Parker Earle. Each important strawberry center has its own list of favorites, varying according to locality; in Oswego County, for example, Parker Earle and Bubach are preferred to Wilson and Crescent. The most popular early variety is Michel, with Crescent ranking second. Parker Earle and Gandy are recommended as late berries. The Crescent is considered the most productive variety, with Wilson and Warfield ranking second and third. As shippers, Wilson, Parker Earle, and Warfield received the greatest number of votes. In regard to the best berry for home use 31 varieties are mentioned by 101 correspondents, Bubach, Crescent, Jessie, and Wilson receiving the most votes for this honor. In all 52 varieties are recommended, but the most prominent are Wilson, Crescent, Bubach, Haverland, Parker Earle, Warfield, Michel, Gandy, and Jessie.

Strawberries and grapes, M. J. HUFFINGTON (*Colorado Sta. Bul. 29, pp. 24*).—Cultural directions for strawberries and grapes, with comparative notes and tabulated data for the varieties grown on the station grounds. For strawberries light or sandy soils are regarded as giving

earlier fruit, while the crop is generally heavier on land possessing some clay. Irrigation is advised in some cases, and potash fertilizers and well-rotted barnyard manure are recommended. The yield of fruit was increased by nitrate of soda applied as a top dressing early in the spring. Mulching is regarded as advantageous because, besides protecting the plants during the winter, it retards their growth in the spring, and thereby lessens the chances of their being killed by late frosts. Thirty-eight varieties were tested, and the dates of blooming and ripening are given. Michel Early is recommended as a desirable extra early berry, while the most attractive berry in appearance and flavor was Edward Favorite. For market varieties are recommended Warfield, Parker Earle, Edward Favorite, Boynton, and Woolverton.

For grapes a warm, well-drained soil, sloping toward the south, is recommended, the vines to be set out in the spring in holes filled in with rich fertilizing substances. Pruning and training on trellises after the fan system is advised, each year trimming down the horizontal shoots to 1 or 2 good buds each. Notes are given for 22 black, 13 red, and 13 white varieties, and the following varieties, in the order of ripening, are recommended for the northern and eastern portions of the State: *Black*—Champion, Moore Early, August Giant, Oriental, Worden; *red*—Brighton, Norfolk, Delaware, Agawam; *white*—Eldorado, Moore Diamond, Martha, Lady Washington.

Asparagus growing, T. V. MUNSON (*Amer. Hort., 5 (1895), No. 2, p. 20*).—A short note on preferred methods.

Experiments toward the protection and improving of asparagus culture (*Ztschr. landw. Ver. Hessen, 1895, No. 4, pp. 27, 28, figs. 3*).

Asparagus culture on a large scale (*Tirol. landw. Blätter, 14 (1895), No. 5, pp. 44–46*).

Sweet potatoes, R. L. BENNETT and G. B. IRBY (*Arkansas Sta. Bul. 31, pp. 16–19*).—The Yellow Yam and Vineless were tested at Newport and at Camden. As a food for hogs the Vineless was preferred. Directions for the cultivation of sweet potatoes are given.

Garden vegetables and tobacco, B. C. BUFFUM (*Wyoming Sta. Rpt. 1894, pp. 24–30*).—A reprint from Bulletin 17 of the station (E. S. R., 6, p. 133).

The Vitis æstivalis group of wine grapes, F. A. WAUGH (*Amer. Hort., 5 (1895), No. 2, pp. 18–20, figs. 2*).—Descriptive and comparative notes on some of the leading varieties of this group, Herman Jaeger, Jaquez, Norton Virginia, Herbemont, and Cynthiana being figured. The last two are considered especially valuable for wine.

The fertilizing constituents removed from the soil in wine, A. MÜNTZ (*Jour. Agr. Prat., 59 (1895), No. 13, pp. 472, 473*).

Chestnuts, W. A. TAYLOR (*Amer. Hort., 5 (1895), No. 2, pp. 28, 29*).—The Spanish and Japanese varieties are compared with the native chestnuts, and considered of inferior quality. Grafting the imported varieties on to American stocks is advised and further developing of choice varieties urged.

Notes on agriculture, B. D. HALSTED (*Science, n. ser., 1 (1895), No. 14, pp. 376–378, fig. 1*).—Notes are given on electro-horticulture, soil treatment of orchards for drought, Russian thistle, and beet leaf spot and its remedies.

Progress report on fruits and trees, B. C. BUFFUM (*Wyoming Sta. Rpt. 1894, pp. 31–34*).—A reprint from Bulletin 17 of the station (E. S. R., 6, p. 55).

FORESTRY.

Osier culture, P. MOUILLEFERT (*Prog. Agr. et Vit., 12 (1895), No. 7, pp. 173–179*).

The bull pine in the West, C. A. KEFFER (*Garden and Forest, 8 (1895), pp. 163, 164*).—Notes are given of *Pinus ponderosa*, showing its adaptability for planting in the Western States.

The Scotch pine in the West, C. A. KEFFER (*Garden and Forest, 8 (1895), p. 142*).—The author states that where this tree has survived the first year no conifer gives better results in the West where tried than this one.

The white pine in the West, C. A. KEFFER (*Garden and Forest, 8 (1895), p. 132*).

Pinus banksiana in the Nebraska sand hills, C. A. KEFFER (*Garden and Forest, 8 (1895), pp. 152, 153*).—A favorable report is given of experiments to grow this tree in the sand hills of western Nebraska.

Trees of minor importance for western planting, C. A. KEFFER (*Garden and Forest, 8 (1895), pp. 122, 123*).—Notes are given on ailanthus, Kentucky coffee trees, Russian poplars, and willows, sycamore, basswood or linn, plums, and choke and sand cherries.

Forestry and the abandoned farm, C. S. PLUMB (*Garden and Forest, 8 (1895), p. 162*).

Forestry at Michigan Agricultural College, W. J. BEAL (*Garden and Forest, 8 (1895), pp. 148, 149*).

Ornamental, forest, and shade trees, E. S. RICHMAN (*Utah Sta. Bul. 37, pp. 11, 12*).—Note on the trees growing at the station, the poplars being recommended as the most promising for general forestry purposes, while it is believed that the growing of some of the hard-wood trees, such as the black and white walnuts and ash, can probably be made profitable.

Forest trees, B. C. BUFFUM (*Wyoming Sta. Rpt. 1894, pp. 34, 35*).—A reprint from Bulletin 17 of the station (E. S. R., 6, p. 56).

SEEDS—WEEDS.

Further studies of the weed seeds found in American clover seed, O. BURCHARD (*Landw. Vers. Stat., 45 (1895), No. 5 and 6, pp. 469–476, tables 2*).—This article is a continuation of a previous paper[1] of the author on the origin of American clover seed as determined by the accompanying weed seeds. In the present article detailed descriptions are given of what the author considers some of the more characteristic weed seeds found in clover seed imported from this country. The following are described and most of them are illustrated by means of photogravures: *Teucrium canadense*, *Euphorbia preslii*, *Phacelia tanacetifolia*, *Paspalum læve*, *P. ciliatifolium*, *Solanaceæ* "*E*," *Euphorbia* "*D*," *Tiliaceæ* "*A*," *Hyoseris scabra*, *Hedeoma pulegeoides*, and *Plantago hookeriana* [probably *P. aristata*].

Effect of alkaloids on the germination and development of seeds, M. MOSSO (*Arch. ital. Biol., vol. 21, p. 231; abs. in Chem. Ztg., 18 (1894), No. 102, Repert., p. 328*).—The author made an investigation of the effect of various alkaloids on the germination and growth of seeds of *Phaseolus multiflorus*. The following were used in solutions of 0.0001, 0.0005, 0.001, 0.005, 0.01, 0.05, 0.1, 0.5, 1, and 2 gm. in 100 cc. distilled

[1] Landw. Vers. Stat., 43 (1893), No. 3 and 4, p. 239 (E. S. R., 5, p. 911).

water: Morphin, nicotin, cocain hydrochlorate, strychnin, atropin sulphate, and caffein salicylate. The experiment was conducted for 18 days, and comparisons were made with equal lots of seed soaked with water. It was found that cocain and atropin 0.01 per cent, strychnin 0.05 per cent, morphin 0.001, and atropin 0.0005 hastened germination, while the more concentrated strengths delayed it. For the caffein no accelerated results were secured, due, in the author's opinion, to the action of the salicylic acid. The author believes that alkaloids will have a narcotic or stimulating effect on plants as well as on animals according to the dose.

The influence of certain salts on germination, A. BRUTTINI (*Staz. Sper. Agr. Ital., 27 (1894), p. 30; abs. in Chem. Ztg., 18 (1894), No. 102, Repert., p. 328*).—The author conducted experiments on wheat with 1 and 2 per cent solutions of the substances mentioned below, the seed being soaked for 24 hours prior to planting. Each lot contained 15 seeds, and at the end of 4 days the following germinations were shown:

Germination of wheat treated with various salts.

Kind of salt.	Number of seed germinated.		Kind of salt.	Number of seed germinated.	
	2 per cent.	1 per cent.		2 per cent.	1 per cent.
Mercuric chlorid	0	0	Potassium sulphocyanid	10	14
Ferric chlorid	0	2	Uranium nitrate	10	13
Platinum chlorid	3	6	Cobalt chlorid	11	14
Potassium cyanid	4	6	Potassium phosphate	12	14
Copper nitrate	5	6	Potassium ferrocyanid	12	13
Manganese phosphate	5	7	Sodium chlorid	12	13
Barium permanganate	6	8	Calcium chlorid	12	15
Nickel chlorid	6	9	Potassium permanganate	13	14
Ammonium chlorid	7	12	Barium chlorid	13	13
Ammonium sulphocyanid	8	12	Potassium nitrate	15	15
Copper sulphate	9	13	Distilled water	15	15
Potassium ferricyanid	9	13			

The germination of seed, WERNICKE (*Ztschr. landw. Ver. Hessen, 1895, No. 8, pp. 57, 58*).—The author experimented with various seeds which, owing to their thick or nearly impervious seed coats, are usually very slow in germinating. The ones experimented upon were *Acacia molissima* and *Lathyrus* spp. particularly *L. sylvestris wagneri*. He subjected them to hot water for various times, after which the seeds were planted in sand in flower pots. Seeds without any treatment gave 50 per cent germination, those soaked for 6 hours in water at 122° F. gave 60 per cent, those soaked for 3 hours at 167° F. gave 72 per cent, and those treated for an hour with water heated from 204 to 212° F. gave 92 per cent germination.

Squirrel-tail grass, A. NELSON (*Wyoming Sta. Rpt. 1894, pp. 73–79, pls. 4, fig. 1*).—A reprint of Bulletin 19 of the station (E. S. R., 6, p. 640).

DISEASES OF PLANTS.

Some fungus diseases of beets, B. D. HALSTED (*New Jersey Stas. Bul. 107, pp. 13, figs. 5*).

Synopsis.—The author reports upon beet scab, root rot of beets, leaf spot, beet rust, white rust, and downy mildew.

Beet scab (pp. 3, 4).—The identity of the scab of beets and potatoes[1] is mentioned, and the necessity of avoiding the planting of one crop where a diseased crop of the other has previously grown.

Root rot of beets (pp. 4–6).—While examining a store pit of beets a fungus was obtained which affected the roots, causing them to be slightly shrunken and almost coal black in color, this discoloration sometimes extending fully to the center of the root. The surface or affected part was dotted with minute specks, which upon examination proved to be the pycnidia of a species of *Phyllosticta*. When placed in moist cloths and kept warm the young patches on the diseased roots soon develop the pycnidia in abundance. It was noticed that the fungus easily penetrates the cloth and develops the pycnidia on its upper surface; and this fact was taken advantage of by the author to secure, in a comparatively easy way, pure cultures of the fungus. Two years before a *Phyllosticta* was found upon the leaves of garden beets, and a comparison of the pycnidia taken from the roots in question and compared with those on the leaves showed that they are probably the same species. It was noticed that the beets in the storage pit in several instances still had adhering to them shreds of old leaves, and in some cases the patches of decay were located beneath such closely adhering leaves. Healthy roots obtained from a field where no *Phyllosticta* was found on the foliage were placed in a box and surrounded with fresh leaves obtained from a field at a considerable distance. In 10 days several diseased patches developed upon the surface of the beets and appeared the same as those previously studied. As the leaf is more susceptible to the disease than the root the author thinks a practical preventive of the spread of the disease to the root may be secured by exercising care in the removal of all foliage before roots are stored.

Beet leaf spot (pp. 7–11).—This is a leading fungus disease of the beet in New Jersey and is caused by *Cercospora beticola*. It seems to affect all varieties of the beet, and makes no distinction between the early and later planted ones. Its appearance upon the leaves is first noticed by the presence of small, light, ashy colored spots, which later often become holes by the disappearance of the tissue previously killed by the fungus. During the past season field experiments were made with fungicides for the prevention of this disease. The ones tested were Bordeaux mixture and ammoniacal copper carbonate, each being used in three strengths. The Bordeaux mixture full strength was made from freshly slacked

[1] North Dakota Bul. 4 (E. S. R., 3, p. 619).

lime and sulphate of copper, each 5 lbs., and water 25 gal., the other strengths being made by increasing the amount of water so as to make solutions of one half and one fourth strength. The ammoniacal copper compound for full strength consisted of 5 oz. of copper carbonate dissolved in 3 qt. of ammonia and 30 gal. of water. For the weaker solutions water was added to secure the one half and one fourth strength. The sprayings were begun on June 21, when the beets were 6 weeks old, and were continued at intervals of 10 days until 10 sprayings had been made. All the ammoniacal solutions were too strong, the foliage being burned wherever they were used.

The use of Bordeaux mixture caused so striking a difference in the plants as to be readily observed in passing the field. The untreated rows had small foliage, more upright and badly spotted leaves, while the sprayed plants showed a rank growth of leaves, nearly green throughout, with much less spot than the untreated plants. The usefulness of Bordeaux mixture as an insecticide was shown in one instance. The insects, which had been feeding on turnips, invaded the beet field, in some instances stripping the foliage of the untreated rows; those treated with Bordeaux mixture were left free. An increase of nearly 26 per cent in weight of plants was secured from the plants on which the Bordeaux mixture had been used, showing that the leaf spot of beet can in a large measure be controlled by the use of this fungicide.

Beet rust (p. 11).—The beet rust (*Uromyces betæ*) has not yet appeared in New Jersey, but the author gives a brief description of it and advises growers to be on the lookout for its appearance.

White rust of beets (p. 11).—This disease, caused by *Cystopus blitii*, is mentioned as a possible enemy. Probably the same fungus is not uncommon upon various weeds, *Amarantus* and the *Blitum*, spp.; and such weeds should be destroyed lest they spread the disease to the beet.

Downy mildew (p. 13).—This disease, caused by *Peronospora schachtii*, is briefly described, but it has not yet appeared in this country.

Further observations upon the effect of soil conditions upon the development of the potato scab, H. J. WHEELER, J. D. TOWAR, and G. M. TUCKER (*Rhode Island Sta. Bul. 30, pp. 66–85, figs. 22*).—In this bulletin is given a continuation of investigations of the authors, reported in Bulletin 26 of the station (E. S. R., 5, p. 590), on the influence of air-slacked lime upon the development of potato scab. The authors are strongly inclined to question whether the corrosive sublimate, or any other treatment which does not seriously impair the vitality of the tuber, will destroy all germs on contaminated seed tubers.

A series of plat experiments was conducted in 1894 to test the effect of the use of lime on the acid soils of the station, the efficiency of the corrosive sublimate treatment, the value of soda as a substitute for potash, and pot experiments to determine the effect, if any, of using other forms of lime than carbonate.

In the first experiment the limed plats had received $2\frac{1}{2}$ tons per acre of air-slacked lime in 1893, and $\frac{1}{2}$ ton additional in 1894. One lot of seed tubers treated with corrosive sublimate was planted on soil that had not grown potatoes for many years. A second lot of untreated tubers was planted on soil supposed to be uncontaminated, while a third was planted on soil that had grown a crop of potatoes in 1893. The limed plats in all 3 cases produced scabbed potatoes, while the acid soils gave scabbed tubers only in 2 cases where untreated seed had been used. Sugar beets grown between the rows where no potatoes had been previously raised were in all cases free from scab, showing that the disease does not spread laterally with very great rapidity.

In the second experiment to test the value of the corrosive sublimate treatment, no potatoes had been grown on the plats for at least 10 years, and the application of lime was the same as in the previous experiment. The authors summarize their conclusions on this experiment as follows:

"(1) In every instance there is a greater percentage of scabbed tubers on the limed than on the unlimed sections where the seed tubers were not previously treated with corrosive sublimate solution.

"(2) The treatment with corrosive sublimate solution appears to have unquestionably reduced the percentage of scab upon the limed sections.

"(3) In case of the unlimed sections, there was in one instance a greater percentage of scab where the seed tubers received the corrosive sublimate treatment, while in the three other instances the per cent of scab was less. These results are contradictory in two instances, and in the other two the differences are so slight that as a whole no practical advantage from the treatment is apparent.

"(4) It will be seen that without exception some scab resulted on both limed and unlimed sections of the plat, even when the corrosive sublimate treatment of the seed tubers was employed. Bearing in mind that beets, grown in another place upon soil known to have been previously contaminated with the germs of the disease, were badly scabbed, and in consideration of the fact that beets have in no other instance been found to be scabbed when grown on any of the plats in the vicinity, we have striking circumstantial evidence from the scab upon the tubers grown from treated 'seed' that they probably owed their diseased condition to the introduction of undestroyed germs on the seed tubers and not to the preëxistence of the germs in the soil itself."

In the third experiment the primary result was not a study of potato scab, but the tabulated results show a tendency of lime to increase the potato scab.

In the pot experiments the object was to test the effect of different forms of lime on scab development. It is claimed that wherever lime in the form of carbonate or in forms capable of producing carbonates was used the per cent of scab was increased. Sulphate of lime gave conflicting results. Calcium chlorid gave least scab, but it injured the growth of the potatoes. No attempt is made to draw definite conclusions from this series of experiments.

The authors conclude as follows:

"Experiments with air-slacked lime covering a period of 2 years show conclusively that it tends to increase the scab of potatoes.

"Since wood ashes contain about one half as much lime in practically the same form, there remains almost no question but that they will also increase the scab. One ton of air-slacked lime contains in general a little less than 2 tons of wood ashes.

"It seems probable that the natural acidity or sourness of the soil tends to check the spread of the disease, and the tendency of barnyard manure to increase it may reasonably be attributed to its alkaline action, by which the sourness is overcome.

"If the farm stock is fed on scabbed beets or potatoes in an uncooked condition, then barnyard manure may still further increase the disease by carrying to the soil germs which have passed through the digestive organs of the animal undestroyed. If a soil is very acid small quantities of barnyard manure, wood ashes, and air-slacked lime will probably have far less tendency to increase the scab than when large quantities are used. The amounts which it would be safe to apply are doubtless dependent upon the sourness of the soil. The safest course, until absolutely effective means of disinfecting the seed tubers are found, would be to avoid these substances altogether, provided potatoes are to be grown successively or in frequent rotation upon the same land. Upon such soil lime not only increases the total yield but also the percentage of tubers of large size, so that if only one crop were to be grown the use of lime would prove decidedly beneficial, for the effects from the scab are not serious the first year. When grown under these conditions, the corrosive sublimate treatment has lessened decidedly the amount of scab. It is possible by the use of this treatment that potatoes may be grown upon limed soil successively or in frequent rotations without the arising of serious injury from the scab, yet our observations up to the present time make it appear very doubtful if this can be done."

Experiments conducted with about 50 agricultural plants show that lime favors the growth of most of them, and the development of scab on potatoes is the only drawback to its general use on acid soils that has so far been observed by the authors.

Report of the botanist, L. R. JONES (*Vermont Sta. Rpt. 1893, pp. 41–69, figs. 7*).—The author gives detailed reports on experiments in spraying potatoes; time and rate of growth of potato tubers and effect of premature death of potato tops on the yield; relation of time of planting potatoes to diseases; and a spray cart for potatoes. These different articles are in the main reprinted from Bulletin 40 of the station (E. S. R., 5, p. 988).

In the experiments in spraying potatoes the author reports in detail on the use of Bordeaux mixture, ammoniacal copper carbonate, copper and ammonium carbonate solution, modified eau celeste, sulphosteatite and copper sulphate of various strengths of solution. The author considers that Bordeaux mixture is the best fungicide for the prevention of potato diseases.

A report is given on the loss occasioned by oat smut in Vermont in 1893. Ninety-eight fields were sampled, the total number of heads examined being 39,826, showing that 0.82 per cent was smutted. A comparison of Vermont-grown seed with that grown in other localities shows less smut from the home-grown seed.

Black knot of plums and cherries and methods of treatment, E. G. LODEMAN (*New York Cornell Sta. Bul. 81, pp. 635–656, figs. 6*).—According to the author the black knot of plums and cherries, which

is due to *Plowrightia morbosa*, was first troublesome in the eastern part of the United States, and it has spread westward through the introduction of diseased plants from the East. The life history of the fungus is given in considerable detail and various remedial treatments suggested. In 1893 some experiments were begun at the station for the prevention of the disease. A thicket of Morello cherry trees and sprouts was taken for the experiment, and 5 applications of Bordeaux mixture made in that year. In 1894, after 1 application of the fungicide, all the knots were cut out and counted on the treated and untreated portions of the plat. During this year 8 applications of Bordeaux mixture were made, and on November 26 the new knots were removed from both the sprayed and unsprayed portions. On April 25 the knots removed from the unsprayed portion were 2,002; the sprayed, 1,155. On November 26 the number of knots removed from the unsprayed portion was 3,529, of which 3,466 were new knots; from the sprayed portion 240 knots were removed, of which 165 were new, showing that the application of the fungicide had materially decreased the disease.

The author recommends the following treatment: Spray (1) during the latter part of March or early in April, (2) when the buds begin to swell, (3) as soon as the new knots begin to show their velvet coating, (4) at intervals of 2 or 3 weeks as may seem necessary.

As some of the applications for the control of black knot are made at a time when other diseases require treatment, but little extra labor is involved in the spraying for the prevention of knots. The author thinks that the spraying of plums and cherries to protect them from the black knot fungus can be carried on with profit in all sections where this disease threatens to interfere seriously with the profitable cultivation of these fruits. A bibliography of the black knot literature is included in the bulletin.

Aureobasidium vitis, G. de Lamarliere (*Rev. Mycol., 17 (1895), No. 2, pp. 54–56*).—A review of recent literature, with critical notes.

Notes on Fusicoccum abietinum, R. Ferry (*Rev. Mycol., 17 (1895), No. 1, p. 25*).

Recent observations on the external characters of black knot, G. Lavergne and E. Marre (*Rev. Vit., 2 (1894), p. 498*).

Recent investigations on the common mold (Penicillium glaucum), Elfving (*Bot. Centbl., 61 (1895), p. 154*).

The cherry fruit mold, B. D. Halsted (*Garden and Forest, 8 (1895), pp. 137, 138*).—A brief description is given of *Monilia fructigena* and its attack on cherries, plums, and peaches.

Some new or little known fungi of cultivated plants, Prillieux and Delacroix (*Bul. Soc. Mycol. France, 1894, p. 161*).—Notes are given of *Septoria petroselini apii* on celery, *Colletotrichum oligochætum* on melons, *Macrophoma vestita* on the roots of *Theobroma cacao*, and *Fusarium sarcochroum* on ailanthus.

New German grain fungi, B. Frank (*Ber. deut. bot. Ges., 13 (1895), No. 2, pp. 61–65*).—Critical notes are given of *Leptosphæria herpotrichoides*, *L. tritici*, *Sphærella basicola*, n. sp., *Ophiobolus herpotrichus*, *Septoria exitialis*, *S. graminum*, *S. glumarum*, *S. briosiana*, *S. avenæ*, n. sp., *Ascochyta graminicola*, and *Phoma hennebergii*.

Diseases of lettuce and radishes, L. H. PAMMEL (*Amer. Gard., 16 (1895), No. 36, p. 150*).—Descriptions are given of *Botrytis* and *Cystopus* on the above plants.

Leaf blight of the strawberry, L. H. BAILEY (*New York Cornell Sta. Bul. 79, pp. 600–602, fig. 1*).—Brief illustrated remarks are made on the blight or rust of strawberry leaves (*Sphærella fragariæ*) which affects different varieties to a varying extent. Spraying with Bordeaux mixture, and prophylaxis by setting healthy plants on clean land, is recommended.

Anthracnose of watermelon, F. A. WAUGH (*Amer. Hort., 5 (1895), No. 4, p. 61, fig. 1*).—Notes on the prevalence, extent of injury, method of attack, and treatment of this disease.

The polyporus of olives (*Prog. Agr. et Vit., 12 (1895), No. 13, p. 348*).—A brief note is given calling attention to the presence of *Polyporus fulvus oleæ* on the olive trees of Italy.

Strawberry leaf curl, B. D. HALSTED (*Garden and Forest, 8 (1895), p. 148*).—A new form of disease, probably due to *Sphærella fragariæ*.

On brunissure of grapes, U. BRIZI (*Bul. Soc. Bot. Ital., 1894, p. 283*).

The bacterial gummosis of the grape, PRILLIEUX and DELACROIX (*Prog. Agr. et Vit., 12, (1895), No. 11, pp. 271–277; No. 12, pp. 312–321*).—Reprinted from *Annales de l'Institut Agronomique.*

Report on a disease of chestnuts in Bretagne, France, L. CRIÉ (*Bul. Min. Agr. France, 13 (1894), pp. 884–892*).

An orchid disease, G. MASSEE (*Ann. Bot., 9 (1895), No. 33, p. 170*).—A preliminary report is given of a brown spot disease of orchid leaves caused by *Plasmodiophora orchidis*. A more detailed description is promised later.

A disease of the plane tree, LECLERC DU SABLON (*Rev. Mycol., 17 (1895), No. 2, pp. 57–59, table 1*).—Illustrated description given of a disease due to *Glœosporium platani*.

The prevention of potato scab, L. R. TAFT (*Mich. Press Bul., Jan., 1895, pp. 4, figs. 3*).—Directions are given for the treatment of seed potatoes with corrosive sublimate for the prevention of scab.

The use of lysol to prevent mildew, L. DEGRULLY (*Prog. Agr. et Vit., 12 (1895), No. 14, p. 355*).—The author advises caution in its use and recommends that it should not be used in greater strength than 0.5 per cent.

New remedies for grape mildew, J. DUFOUR (*Chron. Agr. Canton Vaud., 8 (1895), No. 4, pp. 78–80*).—Methods for preparation are given for a copper and molasses mixture, copper and tannin mixture, lysol, and a powder from which Bordeaux mixture can be made.

The preparation of Bordeaux mixture, E. G. LODEMAN (*Garden and Forest, 8 (1895), pp. 159, 160*).—The author prefers weighing the substances to form the mixture or depending on the color to the potassium ferrocyanid test. He shows the necessity of an excess of lime in the mixture to prevent injurious changes that take place in neutral mixtures.

Bordeaux mixture and color tests, S. A. BEACH (*Garden and Forest, 8 (1895), p. 128*).—Notes are given on the use of potassium ferrocyanid in testing Bordeaux mixture, and where the preparation is in inexperienced hands the ordinary method of weighing is to be preferred.

A kerosene attachment for spraying pumps, E. S. GOFF (*Garden and Forest, 8 (1895), p. 143, figs. 2*).

How and when to spray (*Amer. Gard., 16 (1895), pp. 146, 147*).—A spray calendar with formulas for fungicides and insecticides is given.

Spraying potatoes, L. R. JONES (*Vermont Sta. Rpt. 1893, p. 20*).—A summary of Bulletin 40 of the station (E. S. R., 5, p. 988)

ENTOMOLOGY.

The cabbage root maggot, with notes on the onion maggot and allied insects, M. V. SLINGERLAND (*New York Cornell Sta. Bul. 78, pp. 481–577, figs. 18*).

Synopsis.—An elaborate illustrated paper on the cabbage root maggot (*Phorbia brassicæ*), giving in detail the description, life history, and the results of extended experiments with remedies against its ravages. Brief comparative notes are also given for several allied species. Injecting carbon bisulphid into the ground a few inches from each plant is recommended as the most effective method of destroying the pest, although the application of carbolic acid emulsion is also advised.

The work recounted in this bulletin was undertaken at the request of numerous cabbage growers on Long Island, where extensive growing of cabbages is done and where the cabbage root maggot for many years has proved a pest, annually destroying many acres of the vegetable. The insect was first noticed in the United States in 1835, being introduced from Europe into Massachusetts, and from there has since gradually spread over the greater portion of the United States and Canada, where it is now sufficiently abundant to destroy thousands of acres of cabbages, cauliflowers, radishes, and turnips every year. Although the favorite and presumably native food plant of the insect is *Brassica oleracea*, embracing the cabbages, kales, collards, brussels sprouts, cauliflower, and broccoli, quite a range of food plants is shown, apparently, however, confined chiefly to *Cruciferæ*. In addition to the vegetables mentioned the radish, turnip (*Brassica rapa*), ruta-baga and swede (*B. campestris*), common winter cress (*Barbarea vulgaris*), and hedge mustard (*Sisymbrium officinale*) are attacked. Breeding experiments, evidence of other observers, and comparative study of cabbage and radish maggots seem to indicate that the cabbage and the radish maggot are the same species. The similar maggots infesting onions, beans, and raspberry canes are different insects, distinct from each other and from the cabbage root maggot.

The plants first show the effects of the presence of the maggots after they have been set in the field 2 or 3 weeks, on Long Island about May 15, the time, however, varying with season, locality, and latitude. The first indication is shown by a checking of the growth of the plant, a tendency to wilt badly under a hot sun, and a sickly bluish cast to the foliage, following which the plant in a few days wilts, falls over, and dies. The result is affected by the size of the plant, the number of maggots at work, and the soil and weather conditions, a rich soil and plenty of moisture enabling the plants to withstand the attacks of the maggot for a long time.

"The full grown cabbage maggot is about 0.32 in. (8 mm.) in length, white, cylindrical, tapering cephalad and obliquely truncate caudad, with 12 fleshy tubercles around the caudal margin, the lower two of

which are 2-toothed; and the cephalic spiracles have 12 divisions." The pupa is shorter, measuring about 0.2 in. in length, and is of an elliptical ovate form, and light brown, becoming darker with age. Specimens are easily found in the soil about infested plants in June.

Illustrations from micro-photographs of both sexes of the adults are given. By a casual observer the adult fly might be mistaken for the common house fly, which it resembles in general appearance, but from which it differs by its smaller size, being only about 0.2 in. (5 mm.) in length. The sexes differ considerably in appearance, as is shown by the following descriptions:

"The male fly is of a general dark ash-gray color, with 3 rather broad blackish dorsal stripes on the thorax, and a wide, black, dorsal stripe extending along the abdomen, becoming narrower toward its extremity and more or less dilated opposite the upper margin of each segment, which is marked with a narrower transverse black stripe. Many bristly hairs project from different parts of the body, and the abdomen is subcylindrical, narrow, and but slightly tapering. The eyes, occupying a greater portion of the head, nearly touch each other above. The legs are black and strongly bristled; on the under side of each hind femur near its base is a tuft of these bristles; which are characteristic of this cabbage fly. This tuft is quite noticeable on the femur of the male fly, especially when comparison is made with the corresponding femur of the female; by this character alone the male insect can be recognized and separated from the other common anthomyiian pests. There is also a characteristic row of short bristles, unequal in size, on the inner side of the hind tibia of the male insect that will help to distinguish the species.

"The female fly is of a lighter ash-gray color, quite indistinctly striped on the thorax and abdomen, and not so strongly bristled as the male. Her eyes are also quite widely separated above. The abdomen is of a more elongate ovate shape with a pointed apex. There seems to be no special characteristic by which the female fly can be recognized and separated from some of the other common anthomyiians; it is necessary that it be found associated with its male to determine it with certainty."

For comparison illustrated descriptions are given of the onion maggot (*Phorbia ceparum*), root maggot (*Anthomyia radicum*), and fringed anthomyiian (*Phorbia fusciceps*). The onion maggot closely resembles the cabbage root maggot in size, shape, and color, but differs in certain anatomical features, especially in the arrangement and number of the fleshy tubercles of the caudal segment. The adult onion fly resembles the cabbage fly, but is slightly larger, and the hind femur is comparatively bare of hair at the base, while in the cabbage fly the base of the femur carries a tuft of hair. The life histories are much the same. But one specimen of the root maggot has been taken in the United States, and therefore no immediate damage is anticipated from it. The maggots of the fringed anthomyiian are much smaller than the onion maggots or cabbage root maggots, and are not nearly so destructive to vegetation. They feed on a number of plants and also on the eggs of the Rocky Mountain locust.

The relation of the cabbage root maggot to the club root of cabbages, which is popularly supposed by gardeners to be caused by the insect, is discussed, and the disease is shown to be due to the cabbage slime

mold (*Plasmodiophora brassicæ*). The disease and maggot attacks may, however, and frequently do, occur on the same plant.

The flies first appear in the latter part of April and the first of May, when the female flies may be seen running over the ground about the cabbage plants endeavoring to find some crevice by means of which they can creep beneath the surface of the soil and deposit their eggs close to the cabbage stem. About 55 eggs are probably laid by each fly, although some hundreds of eggs may be laid about a single plant by different flies. The eggs are white, irregularly ridged and grooved longitudinally on one side, and 0.04 in. in length. The eggs hatch in from 4 to 10 days, depending on the weather, but efforts made to breed the insect from eggs in confinement were unsuccessful. The young maggots immediately attack the surface of the root, rasping out burrows along the surface, and first devoting themselves to the rootlets, after which the main root is eaten and often girdled. The burrows are slimy, and the decaying roots upon the death of the plant give out a sickening odor. The larval stage is believed to be about 3 weeks, when the maggots work their way into the soil an inch or two from the roots and there pupate. The pupal stage continues from 15 days to over 3 months, but the majority of flies issue in about 20 days.

It has been believed that there are 3 or 4 annual broods of the insect, but the investigations show that there are but 2 distinct broods, with possibly a third. The flies of the first brood appear in April and shortly deposit their eggs, from which about three fourths of the second brood appear in June, the remainder emerging at varying times throughout the summer. The maggots of this second brood work on the plants in July, pupate, and some of them emerge as adults the latter part of that month or in August as a third brood, but the majority hibernate as pupæ to emerge the following spring.

As natural enemies are mentioned chickens and rooks, which are fond of the maggots, but in eating them usually pull up the cabbage plants, so that aid of this kind is not advised. In England several small hymenopters are parasitic to the cabbage root maggot, none of which are found in this country. However, a cynipid (*Trybliographa anthomyiæ*) has been bred from pupæ in various parts of the United States, and it is believed will play an important part in checking the pest. In addition a staphylinid beetle (*Aleochara nitida*), in both its larval and adult forms, attacks the maggots and pupæ. In some instances the larvæ of the beetle gnaw their way into the pupæ of the pest, devouring the contents, and undergo their metamorphoses within the shell. A species of *Trombidium* also is an enemy of the cabbage fly, sucking the eggs.

About 70 different methods have been recommended for combating the cabbage root maggot and many of them were employed in the experiments here given. Only 6 are regarded as effective and recommended to be employed, although 9 others are classed as doubtful or

partially effective. The effective methods are divided into preventive and destructive measures. Frames covered with cheese cloth or fine netting and placed over the plants proved an efficient protection against the flies, but are only practicable with small areas and a few choice plants. Tarred paper cards cut hexagonally, with a slit reaching to the center, where a star-shaped cut was made to accommodate the stem of the plant, were applied to the young plants on setting them in the field, and pressed closely down to the surface of the ground. By this means the female fly was unable to get at the base of the stem to lay her eggs, and thus the plants were protected. Two rows of 300 plants each were protected by means of the tarred cards on April 19, and on May 21 less than 50 plants were attacked in each of the rows, while hardly 50 plants remained standing in 4 equal untreated rows used as checks. The cards were made of the paper called "1-ply tarred felt" and were cut out by a stamping tool 1½ in. on the side. This method is believed to afford almost complete protection to cabbages and cauliflowers.

Destructive measures, such as crushing the eggs by rubbing the stems of the cabbages with the fingers every few days and by hand picking the maggots, proved effectual, but the amount of work required will hardly recommend them. Two insecticidal substances proved very efficient, a carbolic acid emulsion and soil injections of carbon bisulphid. The carbolic acid emulsion was made by dissolving 1 lb. of hard soap or 1 qt. of soft soap in a gallon of boiling water, to which 1 pt. of crude carbolic acid was added, and the whole stirred into an emulsion. One part of this was added to 30 parts of water and poured around the bases of the plants, about 4 oz. being used at each application, beginning when the plants were set out and repeated every week or 10 days until the last of May. To bring about the best results some of the earth should be removed from about the plants before pouring on the emulsion. In the experiments none of the cabbages were injured. This method is believed to be a most successful and practicable one for treating radishes, turnips, or onions, but for cabbages and cauliflowers the application of carbon bisulphid is preferred. This is applied by means of a newly devised injector, consisting of a large syringe with a cylinder large enough to hold about 2 qt. of the chemical and so constructed as to deposit from a teaspoonful to a tablespoonful of the liquid at every motion of the piston. The nozzle of the instrument should be inserted into the soil 3 or 4 in. from the plant and pushed downward to a point a little below the roots. The chemical should then be expelled, the injector withdrawn, and the hole filled with earth by means of the foot. One injection is usually sufficient, to be given when the maggots have well appeared. The cost is about 1 ct. for every 10 plants.

The methods designated as doubtful or but partially effective are the application of gas lime, kerosene oil and sand, lime, and liquid manure to the soil, and the employment of cultivation. Of insecticides helle-

bore and kerosene emulsion produced conflicting results. The destruction of the pupæ by destroying the "old stumps," by fall plowing, and by the use of gas lime is also classed among these methods.

Among the numerous methods that have been thoroughly tested and found ineffective or impracticable may be mentioned soil selection, time of planting, trap crops, different fertilizing substances, rotation of crops, and various insecticides. Tobacco decoction and kainit are regarded as not having been sufficiently tested, but are not believed to be desirable.

In conclusion the bibliography and synonymy of the insect are worked up and its identity and relationships discussed.

Report of entomologist, G. H. PERKINS (*Vermont Sta. Rpt. 1893, pp. 119–145, figs. 19*).—Brief popular notes on insecticides and on various insects that proved more or less injurious throughout the State during the year, with prefatory remarks on the nature and methods of investigations in economic entomology and the care and perseverance required.

Directions are given for the preparation of various insecticides, and experiments are mentioned for proving their respective efficiency. Paris green and lime, and kerosene emulsion, are advised for insects attacking the foliage; dilute kerosene emulsion for root-infesting insects; and bisulphid of carbon for grain insects. Experience with potash salts used as fertilizers leads to the opinion that their insecticidal powers have been overrated.

An insect new to the State, *Catastega aceriella*, is mentioned as attacking maple leaves, constructing a web-covered tunnel on the undersides of the leaves. Considerable damage to the shade trees is feared, and spraying with Paris green or arsenate of lead as soon as the caterpillars appear in the spring is advised.

Illustrated descriptive, life history, and remedial notes are given for the horn fly (*Hæmatobia serrata*), apple maggot (*Trypeta pomonella*), and various cutworms, particularly the following: *Agrotis ypsilon*, *Peridroma saucia*, *Noctua clandestina*, *Feltia subgothica*, *Carneodes messoria*, *Mamestra subjuncta*, *Xylophasia devastatrix*, and *Nephelodes minians*.

The horn fly has spread over the most of the State and is causing more or less annoyance. Spraying infested cattle with kerosene, destroying the eggs of the flies by sprinkling quicklime over the droppings, and other common remedies are advised.

The life history of the apple maggot is given in detail, attention being called to the fact that the eggs are laid in the pulp of the apple instead of on the skin and that they are deposited from July until frost, thereby a continuous appearance of adults being provided. Destroying windfalls, preferably by turning hogs into the orchards, is recommended, and burning the grass during the winter in such orchards as are kept in sod. It is believed also that lime, ashes, salt, or similar substances applied to the ground will have the effect of destroying the larvæ at the time of pupation.

Twenty-six species of cutworms are cited as occurring in Vermont, but only those mentioned above are considered worthy of notice in detail. Poisoned trap food, fall plowing, and other usual treatment is recommended.

Habits and metamorphoses of insects (**Coleoptera, Ptinidæ**), **IV**, V. XAMBEU (*Ann. Soc. Ent. France, 63* (*1894*), *pp. 459-504*).—The author introduces this paper with a general account of the characteristics of the larvæ and pupæ of European *Ptinidæ* (=subfamily *Ptininæ*, Lec. & Horn), their habits, mode of occurrence, and injuries done by them. The eggs of one species, *Ptinus irrotatus*, are described. Two hymenopterous parasites are mentioned, and one of them, *Scleroderma* sp., bred from the pupæ of *Ptinus brunneus*, is described in the larva and imago states. The larvæ of the following species of *Ptinidæ* are described in detail: *Hedobia pubescens*, *H. imperialis*, *Ptinus brunneus*, *P. dubius*, *P. ornatus*, *P. germanus*, *P. sexpunctatus*, *P. fur*, *P. aubei*, *P. irroratus*, *P. auberti*, *P. latro*, *Niptus submetallicus*, *N. crenatus*, *N. holosericeus*, *Mozium sulcatum* and *Gibbium scotias*. A bibliography of the biology and notes on geographical distribution conclude the article. Most of these species are of economic importance and a number of them occur also in North America, while others are sure to be imported in the course of time.—E. A. SCHWARZ.

Legislation against injurious insects, L. O. HOWARD (*U. S. Dept. Agr., Division of Entomology Bul. 33, pp. 46*).—This consists of a compilation of the laws and regulations in the United States and British Columbia regarding insecticide work, and providing for the inspection and quarantine of trees, shrubs, fruits, and other objects upon which injurious insects may be introduced. The legislation against injurious insects is quoted from the statutes of California, Oregon, Washington, Idaho, New Jersey, Colorado, Missouri, Kansas, Minnesota, Nebraska, and British Columbia. The laws are more extensive and comprehensive in California, Oregon, and other western States. In the west-central States the legislation is almost entirely against grasshoppers. In addition is given the legislation against foul brood in New York and Utah.

This compiled bulletin is issued to attract the attention of agriculturists and horticulturists toward the necessity for the passage of such laws and to form an easy source of information for persons engaged in the drafting of such regulations.

Spray calendar, E. G. LODEMAN (*New York Cornell Sta. Cir., Feb., 1895*).—This consists of a table showing the times, substances, and methods for spraying various orchard and small fruits and flowers, as preventive means against insects and fungus attacks. The directions for making the applications are briefly and concisely summarized in the different columns of the table. In addition formulas are given for the preparation of Bordeaux mixture, ammoniacal copper carbonate, copper sulphate solution, Paris green, London purple, hellebore, and kerosene emulsion.

Histological observations on the functional adaptations of the epidermic cells of insects, J. CHATIN (*Compt. Rend., 120 (1895), No. 4, pp. 213–215*).

Two new species of Lecanium from Brazil, T. D. A. COCKERELL (*Amer. Nat., 28 (1895), No. 2, pp. 174, 175*).—*L. reticulatum* and *L. baccharidis* are described as new.

The imported cabbage butterfly, A. N. CAUDELL (*Amer. Hort., 5 (1895), No. 2, pp. 22, 23, figs. 3*).—Popular life history and remedial notes, dusting with Paris green being recommended.

The cabbage plusia, A. N. CAUDELL (*Amer. Hort., 5 (1895), No. 2, p. 21, fig. 1*).—A brief popular descriptive note on *Plusia brassicæ*.

The turnip gall-weevil, S. HEATON (*Gard. Chron., 17 (1895), p. 398, fig. 1*).—A description of *Centorhynchus sulcicollis*. Gas lime at the rate of not more than 30 cwt. per acre is recommended as a preventive treatment.

A spring wheat pest, CLAUSEN (*Landw. Wochenbl. Schles. Holst., 45 (1895), No. 11, pp. 162, 163*).

A destructive caterpillar (*Ztschr. landw. Ver. Hessen, 1895, No. 9, pp. 68, 69*).—Notes are given on a silk-spinning caterpillar which has caused considerable damage to the leaves of *Helleboris niger*.

Injurious insects and fungi (*Jour. [British] Bd. Agr., 1 (1895), No. 3, pp. 300–316*).—Illustrated descriptions with suggestions for their repression are given for the woolly aphis and goat moth, and notes on horticultural legislation in British Columbia, cabbage root maggot in America, and wireworms.

Legislation against injurious insects, J. B. SMITH (*Ent. News, 6 (1895), No. 4, p. 122*).—Comments upon Bulletin 33 of the Division of Entomology, U. S. Department of Agriculture (E. S. R., 6, p. 916).

The inefficiency of Botrytis tenella in combating white grubs (*Rev. Scientif., 3 (1894), ser. 4, No. 14, p. 441*).—The author calls attention to the failure of *Botrytis tenella* for the repression of white grubs.

FOODS—ANIMAL PRODUCTION.

Investigations on pepsin digestion, F. KLUG (*Pflüger's Arch. Physiol., 60, No. 182, pp. 43–70*).—The author studied this subject with reference especially to the effect of the strength of the pepsin solution, the percentage of hydrochloric acid it contains, the duration of digestion, and the temperature. Pepsin prepared from the stomach of cattle, swine, and dogs was used, and the products of the digestion were investigated. His conclusions are as follows: (1) Of a number of extracts of a stomach lining made consecutively, the first is less powerful than the later ones. The activity of the first extract can be increased by diluting with water acidulated with hydrochloric acid, or by allowing it to stand for 24 hours before using. (2) For studies in artificial digestion cooked egg albumen is best fitted, but it must be borne in mind that this contains about 0.7 per cent of deutero-albumose. (3) Ammonium sulphate and common salt both retard pepsin digestion, the latter about 0.5 per cent. (4) The quantity of the pepsin in the digestive fluid, that is, the strength of the solution, is of marked effect on digestion. A solution containing 0.5 to 0.01 per cent of pepsin digests best, and the activity of the solution diminishes as it is stronger or weaker than this. Pepsin from the dog is most active in a 0.01 per cent solution, while that from pigs or cattle works best in a 0.1 per cent solution. (5) Pepsin digests best in the presence of 0.5 to 0.6 per cent of hydrochloric acid. Hence, a solution containing 0.1 per cent of

pepsin and 0.6 per cent hydrochloric acid is the most advantageous. Twenty centimeters of such a solution will bring 6 gm. of hard cooked egg albumen into solution in 10 to 15 hours. (6) The digestion progresses rapidly during the first 10 to 15 hours, especially the first 4; after that it progresses very slowly; the formation of peptone and albumoses steadily increases, while by long continued digestion the syntonin gradually decreases. (7) In all the tests made syntonin and albumoses could be detected in the digestive solution within 5 minutes after the digestion had begun. (8) Where the pepsin from cattle and swine was used peptone did not appear until nearly 4 hours after commencing, while with dog pepsin it appeared in 20 to 40 minutes. (9) Since the pepsin from the dog surpasses that from cattle or pigs in activity, it is believed probable that there are different pepsins. (10) Digestion takes place at as low a temperature as 0° C. and increases with increasing temperature up to 50 to 60° C., above which it diminishes and ceases at 80° C. (176° F.). (11) Syntonin (precipitated by neutralizing) and the albumoses (obtained by ammonium sulphate) appear in the digestive solution simultaneously. (12) Syntonin does not occur as a result of the hydrochloric acid alone, but like the albumoses and peptone is a product of the united action of the hydrochloric acid and pepsin. (13) Ammonium sulphate and common salt both retard pepsin digestion, the latter about 0.5 per cent.

Comparing prairie hay with timothy hay, T. L. HÆCKER (*Minnesota Sta. Bul. 35, pp. 65–81*).—This comparison was made on 16 cows divided into 4 lots. These lots were fed grain with timothy hay or prairie hay in alternating periods, silage being added to the ration of 2 of the lots all the time. The grain consisted of a mixture of bran, ground barley, corn meal, and linseed meal.

"The prairie hay secured was fine in blade, of good quality, apparently early cut and not exposed to rain before stacking. It was almost free from swale grass and tall blue joint. The timothy hay was medium fine, rather short, cut early and properly cured, had a fine flavor, good color, and was first grade in every respect."

The analyses of the feeding stuffs used are tabulated, together with the record of the food consumed and milk and fat produced by each cow in the several lots.

In calculating the financial result prairie hay is valued at \$3.20 and timothy hay at \$5.60 per ton. The general summary of results is as follows:

"(1) As between early cut and well cured timothy hay and fine well cured upland prairie hay, cows preferred the prairie hay.

"(2) Prairie hay was at least equal to timothy for the production of milk and butter fat.

"(3) At the present price of the 2 kinds of hay, milk was produced at 13 per cent less cost and butter fat at 12 per cent less cost when prairie hay was fed."

Ensiling soja bean and vetch, J. L. HILLS (*Vermont Sta. Rpt. 1893, pp. 109, 110*).—Soja bean and Russian or villous vetch were each grown on plats containing 2,500 sq. ft., and the green crops cut and ensiled, a part of the soja bean by itself and a part mixed with the vetch.

"After about 6 months the silos were opened and the contents fed out. The cows ate the silages readily, but the quantities were too small to admit of experimental feeding. Both silages kept nicely and had a pleasant aromatic odor."

The losses in ensiling are calculated. These amounted to 14 per cent of the dry matter in case of the soja bean and 25 per cent in case of the soja bean and vetch. The composition of the green material and the silage is given as follows:

Composition of green and ensiled soja bean and villous vetch.

	Moisture.	Composition of dry matter.							
		Crude ash.	Crude protein.	Crude fiber.	Nitrogen-free extract.	Ether extract.	Nitrogen.	Phosphoric acid.	Potash.
	Pr. ct.	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*
Soja bean, green fodder	75.36	12.16	20.29	22.53	41.56	3.46	3.24	0.709	1.775
Soja bean silage	77.16	19.00	17.61	26.09	34.44	2.86	2.81	.625	2.246
Villous vetch and soja bean, green fodder	80.30	14.85	21.46	22.85	35.16	5.68	3.43	.748	2.407
Villous vetch and soja bean silage	81.50	19.73	18.90	27.12	27.21	7.04	3.01	.869	2.935

Feeding test with various silages, J. L. HILLS (*Vermont Sta. Rpt. 1893, pp. 70–81*).

Robertson mixture vs. corn silage (pp. 70–75).—The object of this trial was to compare the composition and the feeding value of silage made from a mixture of corn, horse beans (whole plant), and sunflower heads, as proposed by Prof. J. W. Robertson, of Canada, with silage made from corn alone. Two fifths of an acre of corn, one fifth of an acre of horse beans, and one tenth of an acre of sunflowers were planted for this purpose and cultivated as usual. All except the horse beans did well. Early in October this Robertson mixture was harvested and ensiled in one half of a silo, the other half being filled with ordinary corn. The silo was in poor repair, and the loss in ensiling was unusually large. It amounted to 33 per cent of the dry matter for the corn silage and 43 per cent for the mixed silage. Analyses are given of the materials as put in the silo and of both kinds of the good and spoiled silage. The following table shows the composition of the materials as put in and the silage taken out:

Composition of green and ensiled material.

	Water.	Composition of dry matter.							
		Crude ash.	Crude protein.	Crude fiber.	Nitrogen-free extract.	Ether extract.	Nitrogen.	Phosphoric acid.	Potash.
	Pr. ct.	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*
Corn fodder as put in	77.21	5.42	7.59	23.26	59.49	4.24	1.21	0.430	1.509
Silage mixture as put in	74.91	5.87	10.53	21.36	56.07	6.17	1.68	.497	1.612
Corn silage as taken out	79.16	8.11	10.24	26.00	53.85	3.80	1.65	.470	1.921
Silage mixture as taken out	79.30	8.52	12.10	23.89	50.16	5.33	1.93	.717	2.376

"The effect of the horse beans and sunflower heads in the Robertson mixture is plainly shown in the protein and ether extract percentages.

The feeding value of these 2 kinds of silage was tested in a feeding trial with 5 cows, covering 4 periods of 3 weeks, which began December 24. The trial was rather unsatisfactory, as 2 of the cows were found to be tuberculous and were slaughtered, and the others were removed to an old barn, where they suffered much from the cold and were evidently affected by the changed conditions. The results of the trial are tabulated. Under the conditions prevailing "the mixture did not in these cases appear superior to corn silage in feeding value. We do not feel, however, justified in laying much stress on the results owing to the unfortunate complications."

Rye silage vs. corn silage (pp. 75–77).—Twelve cows were divided into 2 lots and fed during 2 periods of 4 weeks each on rye silage or corn silage, the lots being alternated on these. The cows received corn meal, wheat bran, and hay in addition to the silage. The composition of the corn and rye silage is given.

"The rye silage was much drier than the corn silage and was not relished as well. The cows were induced to eat all they would, yet left a good many orts, and ate but three quarters as much dry matter."

The results of the feeding are tabulated. Considerably more hay was eaten with the rye silage than with the corn silage. About 10 per cent less milk and butter was produced on the rye silage. There was a shrinkage of about 2 per cent in passing from corn silage to rye silage, and a gain of about 2 per cent in changing from rye to corn silage. The indications are that there was a loss of about one half from natural fermentation and fire fanging in ensiling of rye.

Corn and soja bean silage vs. corn silage (pp. 77–79).—Four rows of corn, equivalent to one fifth of an acre, with soja beans planted in the same rows, was harvested and ensiled separately; and for comparison an equal area of the same corn grown without soja beans. The composition of the materials as put in and of the 2 kinds of silage as taken out is given. The 2 kinds of silage were fed to 2 lots of 2 cows each in alternating 18-day periods.

"Both kinds of silage were well relished." . . .

"The milk was richer in both cases during the soja bean and corn silage feeding. This latter appears to be, practically, the only gain made by the addition of the soja bean to the corn.

"It would appear, then, that the addition of this small amount of soja bean plants to the corn in the silos did not materially improve the silage, or increase the milk or butter yields. Planting in the row with the corn was found to be better than planting in separate rows, because of greater economy of room and labor."

Pea and oat, and vetch and oat vs. corn silage (pp. 79–81).—The crops from 2 plats of oats and hairy vetch and 2 of oats and peas were harvested and ensiled together, no effort being made to keep the different kinds separate. This silage was fed out to the herd between October 7 and November 17. Analyses of the materials as put in the silo are given, together with a brief record of the herd while the silage was fed.

"Nearly 7 lbs. more butter were produced by these 6 cows fed 6 weeks on pasture with ensiled oats, vetches, and peas than was made in the 6 weeks immediately preceding, on pasture, old silage, and fresh fodder corn, and nearly 40 lbs. more in the 6 weeks immediately following, when corn and rye silages were eaten.

"It is not claimed that this is a strictly controlled experiment, but it serves to show that oats and vetch, and oats and peas, ensiled, may be expected to produce at least as good returns at the milk pail and in the churn as will corn silage."

Feeding trials with animals, F. E. EMERY (*North Carolina Sta. Bul. 109, pp. 419–449*).

The effect of cotton-seed hulls and meal as cattle food (pp. 419–424).—A discussion is given of the general character and feeding value of cotton-seed hulls and cotton-seed meal, and a review of the results obtained in a number of experiments, principally at the station, in feeding these materials in various combinations to steers and cows. From the experience at hand, rations containing these materials are suggested for fattening and for milk.

"Where it is desirable to feed an animal just sufficient to maintain it without loss, the following rations may be used: Hulls from rather green seed may be fed alone, the particles of seed kernels remaining accidentally with the hulls being counted on for maintenance, or, perhaps, even for slow fattening. . . . With well cleaned hulls, however, some cotton-seed meal must be used, depending somewhat on the animal fed. . . . Probably 8 or 10 lbs. of hulls to 1 lb. of meal, when fed in quantity (as much as can be eaten clean), will support life and maintain the weight of neat stock.

"For slow fattening rations ranging from 7 of hulls to 1 of meal down to 5 or 4 to 1 may be used, depending on the animals fed and skill of the feeder. . . .

"Rations for making good beef quickly may range from 4 to 1 down to 2 to 1, or even 1.5 to 1, as we have fed steers successfully on the latter ration. . . .

"When a cow has passed about 4 or 5 months of gestation, and the flow of milk has greatly diminished, she may be put on a ration of hulls and meal, which may be varied from 4 to 1 to as much as 7 or 8 to 1 of hulls to meal until she has dried off. This will support the cow well. It would be well all this time, however, to be feeding once per day some hay, stover, straw, or let her graze part of each day. For 2 or 3 weeks before calving, the cow's ration should be changed by substituting a succulent diet or bran for the cotton-seed meal."

Cotton-seed meal as a horse food (pp. 425, 426).—Two horses were fed in the first period a ration of clover straw (chaff), corn meal, and ship stuff, on which one horse gained and the other lost in weight. During the second period corn meal and ship stuff were both reduced 1 lb., and 2 lbs. of cotton-seed meal fed instead. During this period both horses gained in weight; there was "an almost regular advance in body weight." In the third period the cotton-seed meal was increased to 3½ lbs. and the clover straw was changed to timothy hay. Neither horse ate the timothy hay well and the period lasted only 8 days.

"Neither horse showed any symptoms to indicate that the cotton-seed meal disagreed with it, but both objected to late-cut timothy hay after crimson clover straw and chaff. . . .

"Later, in reply to an inquiry, Mr. E. d'Alinge, of the Biltmore estate, writes that he has for some time been feeding 2 lbs. per day, except Sundays, to work horses and mules. The ration, with cotton-seed meal in this case, being as follows: 13 to

15 lbs. cut hay and finely cut corn fodder, 4 lbs. wheat bran, 2 lbs. cotton-seed meal, 6 lbs. corn meal; the whole mixed together. On Sundays a change is allowed to whole grain, oats and corn, and uncut hay."

Cotton-seed meal for pigs (pp. 426, 427, 433–436).—Two pigs, weighing about 90 lbs. each, were fed the same ration, except that one received corn meal and the other an equal amount of cotton-seed meal.

"As the result of feeding cotton-seed meal, it may be stated that 4 oz. were fed per day with 32 oz. of wheat bran for 20 days, and 20 oz. per day of cotton-seed meal with 40 oz. of wheat bran for the following 21 days were fed and nearly all consumed by a hearty pig, without faltering; but when 2 lbs. per day were fed, the pig refused to eat so much, and became sick on what was eaten, but recovered on a corn diet. . . .

"Later a little more cotton-seed meal was fed, but, rather than risk the loss of the pig, it was dropped. After feeding a period on corn meal, both were slaughtered and comparisons of live and dressed weights were made. The pig which was fed on cotton-seed meal weighed 25 lbs. less than the other, and dressed 71.21 per cent of live weight. The pig fed on corn meal dressed 73.68 per cent of live weight."

Cotton-seed meal for calves (pp. 427, 436–439).—Three calves were fed skim milk to which one fourth to one half a pound of cotton-seed meal was added. After feeding a month or a month and a half all of the calves died.

"The death of one was due to licking up or eating sand. The other two are supposed to have been victims of some toxic agent in the cotton-seed meal which powerfully affects the nervous system. This apparently attacked three mature cows, probably causing the death of one."

Feeding skim milk to lambs (p. 428).—Ten lambs were fattened on skim milk with wheat bran, oats, corn, and green clover. All of the lambs were very wild. The tabulated financial result shows that "not only was nothing received for the separated milk which was fed, but there was a loss on the other food eaten."

A pig feeding test (pp. 428, 429, 440–447).—Four pigs, weighing from 75 to 100 lbs., were fed in 10-day periods to test 5 different rations composed of wheat bran, cowpea meal, and corn meal mixed in different proportions. The rations for all the pigs were the same except that the food for one was mixed with a little hot water and allowed to stand from one feeding to the next; for another was mixed to a thin slop; for a third was mixed with cold water, and for a fourth fed dry. Skim milk or buttermilk was added to the food. The results of the trial are fully tabulated.

"The addition of sufficient cold water to the grain to make the ration sloppy gave the poorest result in gain, while the dry food gave the best result.

"As to the result of the feeding, the gain in weight paid for the value of the grain fed, and paid also for the separated milk for the 50 days' feeding, from 1.4 cts. to 2.03 cts. per gallon. During the last 50 days there was not enough gain in live weight to pay for the grain fed, and consequently nothing was received for the milk."

A system of feeding young calves (pp. 429, 430, 448, 449).—Receipts are given for foods used at the station for young calves in changing from cows' milk to skim milk. These consisted for the most part of whole milk, skim milk, and linseed meal in different proportions.

Fattening mature steers on cotton seed and cowpea hay, R. L. BENNETT and G. B. IRBY (*Arkansas Sta. Bul. 31, pp. 3–11*).—Two half-grade 3-year-old steers were fed in box stalls for 90 days, beginning January 23. Both received whole cotton seed and cowpea hay, the amount being 13.6 lbs. of seed and 20 lbs. of hay per steer. The steers gained 270 lbs. and 274 lbs., respectively. They were bought at 2 cts. per pound and were estimated to be worth 3½ cts. at the close of the trial. With cowpea hay at $3 per ton and cotton-seed meal at $5, there was a profit of $21.30 for the 2 steers.

"Two small 1½-year-old steers were fed for 35 days in the experiment in exact manner of the 2 large steers. They showed no bad effects whatever from the seed, and made a daily average gain of 3.1 lbs."

Raising dairy bred calves, T. L. HÆCKER (*Minnesota Sta. Bul. 35, pp. 82–92, fig. 1*).—This experiment was made to compare the cost of raising calves on whole milk, and on skim milk supplemented by flaxseed meal, and to note the effects of these 2 rations on the thriftiness of the calves. Nine calves were used, 1 being fed on whole milk during a period of 60 days, while 8 were gradually changed to skim milk and flaxseed meal. The time covered by the trial varied from 12 to 24 weeks with the different calves. The food eaten, gain in weight, and cost of the food per pound of gain are tabulated for each animal, and an analysis is given of the flaxseed meal. The following table gives a general summary of the results:

Summary of feeding experiments with calves.

	Length of trial.	Cost of food.	Weight at end of trial.	Gain in live weight.		Cost of food per pound of gain.
				Total.	Average per day.	
	Days.		*Pounds.*	*Pounds.*	*Pounds.*	*Cents.*
Calf No. 1, whole milk diet	61	$13.88	245	160	1.90	9.69
Calf No. 2, skim milk diet	84	3.48	160	100	1.19	3.49
Calf No. 3, skim milk diet	140	5.07	234	179	1.28	2.88
Calf No. 4, skim milk diet	140	4.82	205	133	.95	3.84
Calf No. 5, skim milk diet	140	5.10	235	150	1.07	3.51
Calf No. 6, skim milk diet	168	6.58	257	192	1.14	3.47
Calf No. 7, skim milk diet	168	7.32	420	338	2.01	2.40
Calf No. 8, skim milk diet	168	5.33	270	210	1.25	2.54
Calf No. 9, skim milk diet	168	6.55	265	193	1.14	3.71
Average for calves fed on skim milk					1.25	3.23

"While the experiment was fairly satisfactory as to the general growth of the calves, the details in feeding were not as carefully carried out as the importance of the work required. It is therefore being repeated with a view of obtaining more accurate data, though it can hardly be expected that our efforts will result in growing a finer lot of calves."

Effect of weather on the quantity and quality of milk, J. L. HILLS (*Vermont Sta. Rpt. 1893, pp. 88–92*).—Observations on this subject have previously been reported by this station in the Annual Reports for 1891 and 1892 (E. S. R., 4, p. 491; and 5, p. 322). In addition to these tests observations are here reported on two other tests. The

first of these was with 17 cows and extended from September 15 to early in November. The cows were at pasture but were stabled during the night. The cows were grouped according to the quality of their milk, and samples of the morning's and night's milk of each group were tested daily with the Babcock test and lactometer. Opportunity was afforded for 72 comparisons of the effect of changes of temperature on percentages of total solids and fat in the milk.

"In cases of general rising quality no connection with weather could be traced. The amount of change was as great one way as another.

"During stationary temperatures, more or less quality fluctuations occurred, but they were found to be equally divided in direction.

"In brief, it may be said that more than half (55 per cent) of the changes in fat percentage, and nearly two thirds (65 per cent) of the changes in per cents of total solids were opposite to those of the thermometer, but that for periods of more than a day the inverse character of the quality change was less marked.

"Coincident with a warm spell [October 15 to 25] the milk flow fell for the first time below the line of calculated natural shrinkage. On the other hand, 5 days averaging as warm (October 3 to 7) were accompanied with a little more milk than usual. There was a marked decrease in quantity early in November, as the weather grew colder."

The other test was with 7 cows stabled in a poorly constructed barn on a bleak hillside, and lasted from February 25 to March 30, 1894. The morning's and night's milk of each cow was tested by the Babcock test. Omitting the times when the temperature varied less than 5° from day to day, there were 40 opportunities for observing the effect of changes of temperature on the milk.

"These show that 21 times the quality change was inverse to temperature change, 13 times in the same direction, and 6 times no quality change followed thermometric fluctuation. Nearly two thirds (62 per cent) of the changes were in the inverse direction to temperature change. They were also more pronounced than the changes in the same direction (0.275 per cent inverse, 0.215 per cent same).

"There were 12 cases of rather decided temperature changes extending over 3 days or more (using both sets of temperatures separately). The general quality of the milk changed inversely 6 times, in the same direction twice, and fluctuated irregularly 4 times. Three quarters of these changes were in the inverse direction."

From a study of the records of the World's Fair test the statement is made that "over half the changes in per cent of total solids, and three quarters of the changes in fat percentages were inverse to thermometric variations. . . . No connection could be traced between temperature and quantity changes (save as high temperature induced lighter feeding and consequent falling off) or between storm, and either quantity or quality change."

The author summarizes the results of the 2 tests previously reported, and taking these in connection with those reported above, draws the following inference:

"These 5 separate tests, covering practically the entire year, and the conditions of pasture, summer soiling, and winter barn feeding, point directly to the conclusion that the tendency of cows is to give from day to day richer milk when the temperature falls and poorer milk as it rises; or, in other words, the quality of the milk (solids and fat) varies inversely to temperature changes."

Cost of butter production in winter, T. L. HÆCKER (*Minnesota Sta. Bul. 35, pp. 54–64, figs. 5*).—In connection with the observations on the herd of 23 cows (p. 928), the cost of producing butter in winter was determined for each cow. The cost of the feed was calculated on the same basis as in the yearly record. Each milking was weighed and tested by the Babcock test and the cows were weighed weekly.

"It was found impossible to make the trial the same length for each cow for the reason that they were not all at the same time in a condition which would make it fair, so each cow was placed on trial at a time when it was thought she would do herself justice."

The trial with different cows lasted between 112 and 181 days. The data given include the average live weight of the cows, the dry matter eaten per day per 1,000 lbs. live weight and per pound of butter fat produced, the butter fat produced per day, and the cost of food per pound of butter fat. These all show very wide variations, the dry matter eaten per 1,000 lbs. live weight varying from 14.60 to 28.24 lbs., the dry matter eaten per pound of butter fat from 18.44 to 31.05 lbs., and the cost of food per pound of butter fat from 10.8 to 17.8 cts.

"It is evident that some cows produce butter fat much cheaper than others, the variation being so great that under certain conditions one class will produce it at a profit and another at a loss."

The author concludes that it is not a question of the size or breed of the cow, but rather of conformation; and he divides the herd into 4 groups on this basis as follows: (1) Beefy cows, (2) those with less tendency to plumpness, (3) cows spare and angular in form but lacking depth, and (4) cows spare and angular with deep bodies. For each of the cows in these different groups the weight is given, the dry matter eaten per 1,000 lbs. and per pound of butter fat, and the cost of food per pound of butter fat, together with the average for each group. The range of variation and the averages are given in the following table:

Record of butter production by groups.

Groups.	Dry matter eaten daily per 1,000 lbs. live weight.			Dry matter eaten per pound of butter fat.			Cost of food per pound of butter fat.		
	Highest.	Lowest.	Average.	Highest.	Lowest.	Average.	Highest.	Lowest.	Average.
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Cts.*	*Cts.*	*Cts.*
1. Beef type, blocky and plump	19.96	14.61	16.66	32.47	28.94	31.25	18.2	16.4	17.5
2. Less tendency to lay on flesh	25.15	16.75	21.02	31.05	24.44	26.42	17.8	13.8	15.1
3. Spare and angular, but lacking depth	23.59	22.09	23.00	28.58	23.75	25.54	16.6	13.4	14.6
4. Spare and angular with deep bodies	28.24	17.87	23.58	23.06	18.44	21.15	12.9	10.8	12.1

These figures show a steady increase from group 1 to group 4 in respect to the amount of dry matter eaten per 1,000 lbs. live weight, but a decrease in the dry matter eaten per pound of butter fat produced and in the cost of food per pound of butter fat.

"The cost of butter fat as indicated in the last column seems to depend more upon the type of cow than the breed, there being less variation in cost of production between cows of a certain type than between cows of the same breed. The cost of 100 lbs. of dry matter was 57 cts. . . .

"The first group consumed, on an average, 20.81 lbs. dry matter per day, returning 4.7 cts. profit [with butter fat at 25 cts. per pound]; the cows in group 2 ate 20.37 lbs. dry matter and gave 7.5 cts. profit; group 3 ate 19.95 lbs. each and returned 8.1 cts., while group 4 ate 21.86 lbs. each per day at a profit of 13.3 cts., or nearly 3 times as great a net profit as the blocky cows in group 1."

The effect of feeding bone meal on the character of the milk, J. L. HILLS (*Vermont Sta. Rpt. 1893, pp. 106, 107*).—To observe the effect of feeding bone meal on the ash and phosphoric acid content of milk, 2 Ayrshire cows were fed 2 lbs. each per day of clean ground bone. The milk was tested for ash and phosphoric acid a number of days before adding the bone meal, and for 10 days after the cows had become accustomed to it. The average results for each cow are given in the following table:

Ash and phosphoric acid in milk before and after feeding bone meal.

	Cow Hilda.		Cow Juno.	
	Ash.	Phosphoric acid.	Ash.	Phosphoric acid.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Before feeding bone meal	0.802	0.2142	0.702	0.1809
After feeding bone meal	.809	.2263	.704	.1919
Gain on bone meal	.007	.0121	.002	.0110

"There appeared little difference in the percentage of ash, but its composition seems to have been slightly changed and the phosphoric acid increased."

Effect of the change from barn to pasture, J. L. HILLS (*Vermont Sta. Rpt. 1893, pp. 107–109*).—Previous observations on this subject have been reported in the Annual Reports of the station for 1889, 1890, 1891, and 1892 (E. S. R., 2, p. 667; 3, p. 477; 4, p. 491; and 5, p. 317). The present observations were on the new station herd of 21 cows. They ate before and after the change a liberal ration of equal parts of corn meal and bran, with hay and silage, and were stabled at night during the pasture period. The milk was tested for 20 days previous to pasture and for the same length of time beginning 10 days after the change. The changes in the milk yield and constituents of each cow in changing from barn to pasture are noted.

"The cows gained in both quantity and quality of the milk, and made more butter on pasture. Out of 21 cows but 2 failed to increase in the milk flow and but 2 lowered its quality as a result of the change.

"The average gain was equivalent to nearly 3 lbs. of milk and nearly a quarter of a pound of butter per day and per cow, while the fat was increased over a third per cent. The quality of milk was increased a seventh, and because of the increase in both the quantity and the quality of the milk, the butter yield was increased nearly a quarter."

The changes noted in the observations previously reported are summarized.

"The evidence appears overwhelming that cows on early pasturage—May and June—make not only more but richer milk than during the last months of their barn life."

Whale flesh meal as a food for milch cows, J. SEBELIEN (*Aas, Norway: 1894, pp. 33*).—A feeding experiment with 20 cows was conducted at Aas Agricultural College to trace the effect of whale flesh meal on milk and butter production. The experiment included 3 main periods, (1) the preparatory period, lasting 32 days; (2) the experimental period proper, lasting 50 days; and (3) the post-experimental period, lasting 20 days. The cows were separated into 2 even lots of 10 each. During the first and third periods both lots were fed a basal ration of 80 kg. of turnips, 90 kg. of cut straw, 40 kg. of hay, 10 kg. each of rape-seed meal, linseed meal, and malt sprouts. Lot A received this ration during the second period also, the quantities fed being somewhat changed; but lot B received 0.5 kg. of flesh meal per head per day during the first 20 days of the second period in addition to the ration in the first period, and later from ½ to 1½ kg. of the concentrated feed in the ration was replaced by a like quantity of flesh meal. The following table gives the average results obtained:

Average daily production of milk and fat per cow.

	Lot A, same feed throughout.			Lot B, whale flesh meal during period 2.		
	Yield of milk.	Fat content.	Yield of fat.	Yield of milk.	Fat content.	Yield of fat.
	Pounds.	*Per cent.*	*Pounds.*	*Pounds.*	*Per cent.*	*Pounds.*
First period	20.08	3.35	0.674	20.13	3.51	0.705
Second period	17.77	3.40	.604	17.97	3.67	.658
Third period	15.67	3.57	.560	15.94	3.64	.580

It would appear that the feeding of flesh meal increased the production of milk and slightly improved its quality. The author concludes that this result will be obtained whether the flesh meal be fed in addition to an ordinary fairly rich ration, or in partial substitution of the vegetable concentrated feeds in the same. If the ration is rather scant and of a narrow nutritive ratio, the addition or substitution of whale flesh meal will produce no increase in the yield of fat, since the milk under such conditions seems to grow thinner, even if the milk yield is increased.

The average live weights of the 2 lots of cows remained nearly unchanged throughout the experiment.

Neither the quality nor the flavor of the butter was apparently affected by feeding as much as 3.3 lbs. of flesh meal per head per day. In a record given of the experience of practical farmers in feeding flesh meal to milch cows, it is stated, however, in one instance that while

butter from flesh meal feeding will be faultless when first made, a fishy taste is apt to appear when the butter is kept for some time. The consensus of opinion among farmers is on the whole favorable to the use of whale flesh meal for cows. The quantities fed ranged from 0.4 to 3.3 lbs. per head per day. Flesh meal is also reported as fed to bulls, growing cattle, swine, and poultry with satisfactory results.—F. W. WOLL.

Dairy herd record for 1893, T. L. HÆCKER (*Minnesota Sta. Bul. 35, pp. 37–53, fig. 1*).—This is a record for the year 1893 of the 23 cows of the college herd, including the kinds, amount, and cost of food eaten; weight of cows and milk and butter fat produced; percentage of fat in milk; and cost of feed. The herd included the following breeds: Jersey, Holstein, Guernsey, Shorthorn, Polled Angus, and crosses and grades of these breeds. The data are given for each of the cows individually.

"No special effort was made to select an economical ration; the cows were fed bran, barley, corn, linseed meal, silage, roots and hay as had been the practice theretofore."

The milk from each milking was weighed and recorded and a sample taken for testing. The data given are discussed in detail.

"The record of the dairy herd for the year 1893 seems to warrant the following conclusions:

"(1) The average annual cost of keeping a dairy cow is $38.

"(2) A herd of cows bred on dairy lines, well fed and carefully handled, will produce on an average 6,400 lbs. of milk per year at a cost of 62 cts. per 100 lbs. and 12½ cents a pound for butter fat.

"(3) A herd of good dairy cows well fed and carefully handled will produce on an average 300 lbs. of butter fat each per year, which is equivalent to 365 lbs. of butter per cow.

"(4) The average cost of a pound of butter will be 10½ cts.

"(5) Taking the entire herd, the average cost of a pound of butter fat during the winter months is 13.9 cts."

Records of the station herd for 1892 and 1893, J. L. HILLS (*Vermont Sta. Rpt. 1893, pp. 81–87*).—This is a detailed record for each cow of the station herd for the years 1892 and 1893. The record for 1892 is reprinted with some additions from the Annual Report of the station for 1892 (E. S. R., 5, p. 320).

The record for 1893 includes 21 cows. It shows the number of days the cows were in milk, the total yield and composition of the milk of each cow, the yield of milk constituents, the calculated yields of butter and cheese, the number of pounds of milk required to make 1 lb. of butter and cheese, and the relation between the value of the entire product from butter and cheese. The butter yield is calculated by assuming 110 lbs. of butter to be made from 100 lbs. of butter fat, and the yield of green cheese is calculated by multiplying the per cent of fat by 1.1 and the per cent of casein by 2.5. The summary of the record for 1893 is as follows:

Average per cow for the year 1893.

	Total yield of milk.	Composition of milk.		Yield of milk constituents.			Calculated yield of—		Milk required per pound of—	
		Total solids.	Fat.	Total solids.	Fat.	Casein.	Butter.	Cheese.	Butter.	Cheese.
	Lbs.	*Per ct.*	*Per ct.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
Average per cow	6,455	13.68	4.38	883	283	182.0	311	758	20.8	8.5
Average 6 mature Jerseys	6,232	14.73	5.22	918	325	198.2	358	853	17.4	7.3
Average 1 mature Aryshire	8,273	12.31	3.57	1,018	295	194.1	325	811	25.4	10.2
Average 4 Holsteins	8,420	12.80	3.73	1,078	314	208.0	345	865	24.4	9.7
Average 3 best Jerseys	7,197	14.66	5.21	1,055	376	228.9	413	986	17.4	7.3

The yield of the herds for 1892 and 1893 as regards quantity and quality of milk are compared, and the composition of the milk of a number of young cows for the first 2 periods of lactation is compared.

"The regular members of the station herd of 1892 averaged 7,197 lbs. of milk and 351 lbs. of butter, while in 1893 the regular members averaged 7,115 lbs. of milk and 341 lbs. of butter. The entire herd made during the same years 147,609 and 135,615 lbs. of milk and 7,014 and 6,541 lbs. of butter.

"Calculations based on Dr. Van Slyke's work indicate that the regular members averaged 856 and 831 lbs. of cheese, and the entire herd produced milk equivalent to 17,154 and 15,926 lbs. of cheese in 1892 and in 1893, respectively. The poorer record for 1893 was partly due to abortion. There was no material change in the quality of the herd milk for the 2 years and but slight variations in the quality of the milk of the individual cows. The 2-year-olds of 1892 gave the same or slightly better quality of milk during their second lactation. The milk, except that of 2 Jerseys, was found to be worth as much for cheese as for butter, at the average market prices. . . .

"If 2½ lbs. of cheese are considered to be equal in market value to a pound of butter, which are fair market conditions, then for every $100 obtained for the herd milk made into butter there would have been received $98 if the milk had been made into cheese."

Pig feeding, J. L. HILLS (*Vermont Sta. Rpt. 1893, pp. 30–40*).

Synopsis.—An experiment on 2 lots of pigs of the effect of feeding bulky as compared with more concentrated food during the early growth of the pigs on the general gain in weight, and on the shrinkage of the pigs in dressing. The difference in richness of the rations was brought about by feeding more or less corn meal in proportion to the skim milk. Those on the narrower rations gained faster and ate less dry matter per pound of gain than those on the wider rations, but the shrinkage on dressing was the same with both lots. At current prices the skim milk fed to the pigs was calculated to have brought about 25 cts. per 100 lbs.

Four Chester Whites and 4 Small Yorkshires were selected for the experiment when about 8 weeks old, and divided into 2 lots with 2 pigs of each breed in each lot. After feeding both lots alike for about 3 weeks the experiment was commenced May 30 and continued until December 10 with the Chester Whites and until January 10 with the Small Yorkshires. Lot 1 (bulkier food) received 2 oz. of corn meal per

quart of skim milk until they were taking 6 qt. of skim milk, when the additional food required consisted of a mixture of equal parts of corn meal and wheat bran until they weighed 200 lbs., when they were finished off on skim milk and corn meal. Lot 2 was fed on skim milk alone until they took 9 qt. per day, when an ounce of corn meal per quart of skim milk was added until 12 qt. was being taken, when the corn meal was doubled until the pigs weighed 150 lbs. each; they were then given all they would eat of the corn meal and wheat bran mixed, and were finished off in the same manner as lot 1. Soon after the beginning of the experiment the 2 Small Yorkshires in lot 1 died.

The data for the experiment, including the gains in live weight by periods, the amounts of food and of dry matter eaten, financial results, and the loss on dressing, are tabulated. The financial results are based on dressed pork at 7 cts. per pound, corn meal at $21 and bran at $17 per ton, and skim milk at 15 cts. per 100 lbs.

A summary is given in the following table:

Summary of results of pig feeding trial.

Lot.		Average gain in live weight.	Shrinkage in dressing.	Dry matter eaten. Per lb. gain in live weight.	Dry matter eaten. Per lb. gain in dressed weight.	Cost of food per pound of gain in dressed weight.	Average profit per pig.
		Pounds.	*Per cent.*	*Pounds.*	*Pounds.*	*Cents.*	
1	Chester Whites, bulkier food	264	13½	3.24	3.73	4.83	$4.84
2	Chester Whites, narrower ration	290	13½	3.17	3.64	5.05	5.09
2	Small Yorkshires, narrower ration	211	16	3.33	3.96	5.58	2.62

"The Chester Whites of lot 2, whose ration was narrower than those of lot 1—

"(1) Gained faster,

"(2) Reached a greater live weight,

"(3) Shrank the same, and

"(4) Ate less dry matter to make a pound of live or dressed weight than did the pigs whose food from the beginning was bulkier. Chester White No. 2 of lot 2, however, weighed no more at slaughter than did the Chester Whites of lot 1, notwithstanding it had eaten 75 lbs. more dry matter. This makes the cost of the food of this pig so high and so reduces the profits that the total profit per pig for the 2 lots is nearly the same. . . .

"The Small Yorkshires grew slowly. . . . They gained less in more time, ate more dry matter to the pound of gain in live or dressed weight, and their food cost more per pound of increase of dressed weight than that fed the Chester Whites. . . . They were kept at a profit, yet the money gain from 7½ months of feeding was but little more than one half that derived from a month's less feeding with the larger breed. . . .

"If the manure is considered to offset the care and the cost of gain is subtracted from the price obtained for dressed pork, the skim milk may be considered to have brought 25 cts. per 100 lbs. The fertilizing value of the food was 58 per cent of its market value."

Proper amount of skim milk for finishing off (p. 37).—From October 11 to December 10 lot 1 received 366 qt. of skim milk and 374 lbs. of corn meal each, and the Chester Whites in lot 2 received 732 qt. of skim milk and 339 lbs. of corn meal each.

"The pigs that ate the most gained the most, but . . . the extra 23 lbs. live weight cost $1.93 more, or 8.4 cts. per pound, whereas it only brought 7 cts. This is a reversal of the results found with 8 pigs last year [E. S. R., 5, p. 318], but, as before stated, pig 3 [in lot 2] did so poorly that he lowered the average and the results are less satisfactory than might be wished."

Pig feeding, L. FOSTER (*Montana Sta. Bul. 3, pp. 35–62*).—This is a popular bulletin discussing the principles of feeding, the average composition of American feeding stuffs, feeding standards, and preparation of food, together with quotations from the work of some of the stations in feeding pigs.

Analyses of milling by-products, J. L. HILLS and B. O. WHITE (*Vermont Sta. Rpt. 1893, pp. 26–28*).—Analyses with reference to food constituents and notes on methods of manufacture are reported for the following materials: Corn oil cake, gluten meal, gluten feed, scorched barley, maize feed, middlings, ground peas and oats, oat hulls, "nutriotone," and peanut meal.

What constituents of wine hinder pepsin digestion? H. PETERS (*Ber. pharm. Ges., 4 (1894), p. 258; abs. in Chem. Ztg., 18 (1894), No. 102, Repert., p. 329*).

Comparative examinations of different meat extracts, A. STUTZER (*Ztschr. angew. Chem., 1895, No. 6, pp. 157, 158*).

Cocoa as a food material, H. COHN (*Ztschr. physiol. Chem., 20, No. 1 and 2, pp. 1–27*).—An extended study of the food nutrients of cocoa and their digestibility as shown by the natural and artificial methods. Artificial digestion showed 64 per cent of the nitrogen digestible, including the theobromin. In a digestion trial on the author himself 52.7 per cent of the protein and 95.38 per cent of the fat were digested.

On roasted chicory, E. G. CLAYTON (*Analyst, 20 (1895), Jan., pp. 12–15*).

Heat production in the chick before and after hatching, M. S. PEMBREY, M. H. GORDON, and R. WARREN (*Jour. Physiol., 17 (1894), pp. 331–348; abs. in Jour. Chem. Soc. London (1895), Feb., p. 51*).

On the nature of muscular contraction, T. W. ENGLEMANN (*Nature, 51 (1895), Mar. 28, pp. 519–524, figs. 2*).

Sugar in the nutrition of animals, A. VIVIEN (*Ind. Lait., 20 (1895), No. 13, pp. 99, 100*).

The feeding of animals for the production of meat, milk, and manure and for the exercise of force, LAWES and GILBERT (*Jour. Roy. Agl. Soc. England, 6 (1895), No. 21, pp. 47–146, tables 2*).—The substance of this article will be contained in a bulletin on the Rothamsted Station soon to be issued by this Department.

Compounding rations for animals, P. FAUCOMPRÉ (*Ind. Lait., 19 (1894), No. 48, pp. 382, 383*).

Feeding milk cows with hairy vetch, C. J. MARTIN (*Ind. Lait., 20 (1895), No. 3, pp. 19, 20*).

The influence of the month of calving on the milk production of a cow, P. SCHUPLI (*Einfluss der Kalbezeit der Kühe auf die Milcherzeugung und auf die Aufzucht. Berlin: Pub. by Molkerei Zeitung, 1894; abs. in Fühling's landw. Ztg., 44 (1895), No. 4, pp. 75–80*).

Peanut oil as a substitute for milk fat in calf feeding (*Landw. Wochenbl. Schles. Holst., 45 (1895), No. 11, pp. 167–169*).

Measurements of hogs of different breeds, JUNGHANNS (*Mitt. deut. landw. Ges., 1895, No. 5, p. 52, fig. 1*).

Heredity in horses, A. OLIVER (*Bul. Min. Agr. France, 13 (1894), No. 8, pp. 892–907*).

Barnyard fowls R. SAINT-LOUP (*Les oiseaux de basse-cour. Paris: J. B. Ballière et fils, pp. 369, figs. 107*).

Characteristics of breeds of chickens, E. LEMAINE (*Agl. Gaz. N. S. Wales, 5 (1894), No. 12, pp. 878–880*).—A tabulated summary giving number of eggs laid, daily increase in weight of chick, weight when 6 months old, and other data for 33 breeds.

VETERINARY SCIENCE AND PRACTICE.

Glanders, W. L. WILLIAMS (*Montana Sta. Bul. 4, pp. 67–113, pls. 7*).—This is a general discussion on the subject in popular form. Among the topics treated are the pathology, symptoms, and diagnosis of glanders; strangles, pink eye, acute nasal catarrh, infectious or epizootic catarrhal fever, chronic nasal catarrh, diseases of the facial sinuses, diseased teeth, and nostril tumors, which have sometimes been confused with glanders. The only safe method of diagnosis is the use of mallein.

"Although most modern investigators admit the curability of some cases of glanders, these recoveries are confessedly few and the treatment of the malady, whether by medicines or mallein, is yet purely experimental, unworthy of confidence from a practical standpoint, yet pointing hopefully toward reliable treatment in the near future. Apparent recoveries from glanders are unfortunately too often apparent only, and serve to continue the spread of the disease."

Experimental trichinosis in Spermophilus 13-lineatus, C. W. STILES (*Vet. Mag., 1894, pp. 727, 728; Centbl. Bakt. und Par., 16 (1894), No. 19, pp. 777, 778*).—The disease trichinosis was given experimentally to spermophiles, but the author does not believe that these animals are of any practical importance in transmitting the disease to hogs.—C. W. STILES.

Discussion of the coccidian origin of cancer, FABRE-DOMERGUE (*Ann. Micrographie, 1892, pp. 49–67, 97–110, 145–164, 221–236, 579–587, 603–614, figs. 27*).—The author's conclusions may be summarized as follows: (1) The parasite theory of cancer, originating in the writings of Pfeiffer, Darier, Wickham, and d'Albarran, rests upon observations which have no connection with one another and no analogy; (2) the objects described as *Sporozoa* have only certain morphological resemblances to these animals, but do not possess coccidian characters; (3) all the pseudococcidia as yet described are connected by insensible gradations with the neoplastic cell, from which they originate by degeneration; (4) epithelial cancers of animals, really homologous to those of man, are also not parasitic; (5) in attempting to demonstrate the necessity of a parasitic origin by comparing epithelial cancers with galls of vegetables and infectious neoplasms of animals one fails to recognize the very nature or essence of cancer and compares conditions which are not comparable.—C. W. STILES.

Notes on parasites, C. W. STILES and A. HASSALL (*Vet. Mag., 1894, pp. 729–741, figs. 11*).—*A new species of intestinal fluke* (*Distomum tricolor*) in the cotton-tail rabbit (*Lepus sylvaticus* Bachman) and in the Northern hare (*L. americanus* Erxleben). This species is found to be common in Maryland, the District of Columbia, and Virginia; it stands midway between the genera *Mesogonimus* and *Urogonimus*, and the authors are doubtful as to the validity of these two genera.

Distomum (*Polyorchis*) *molle* (Leidy, 1856, S. and H., 1894).—Anatomical description of original types of *Monostomum molle* Leidy.—C. W. STILES.

New American finds of Sarcosporidia, C. W. STILES (*Vet. Mag., 1894, pp. 928, 929*).—An undescribed species of *Miescheria* is present in the heart of nearly all cattle examined in the District of Columbia; an undescribed species has been found in rabbits in Illinois by Schimer and in Maryland by Hassall; *Sarcosporidia* were found very common in Iowa rats by Stiles; *Balbiaria* sp. found in *Setophaga ruticilla* by Hassall; an undescribed Sarcosporidium found in chickens by Stiles.—C. W. STILES.

On the genus Gongylonema Molin, L. G. NEUMANN (*Mem. Soc. Zool. France, VII, pp. 463–473, figs. 4*).—A general revision of the genus *Gongylonema* (family *Filariidæ*) based upon material from Africa and India. Revised generic and specific diagnoses are given. The following synonymy and data are given for the forms which occur in domesticated animals:

(1) *G. scutatum* (Müller, 1869) Railliet, 1892 (*Spiroptera scutata œsophagea bovis* Müller, 1869; *Filaria* sev. sp. *scutata* Lkt., 1876; *Myzomimus scutatus* Stiles, 1892) recently found by Fayet in 105 out of 136 cattle examined at Tébessa (Algeria); the parasite occurred in nearly every animal infested, in the thoracic portion of the œsophagus. Fayet found the same thread worm in 14 per cent of 494 sheep examined at Tébessa, and Boulant found it in nearly all the sheep slaughtered at Sétif. Fayet also found it in (34=) 32 per cent of the goats examined. It has also been found in the horse (Müller).

(2) *G. pulchrum* Molin, 1857, was found by Fayet in the œsophogeal epithelium of 5 out of 20 hogs.

(3) *G. verrucosum* (Giles, 1892) Neumann, 1894 (sp. *verrucosa* Giles, 1892; *G. scutatum* Railliet, 1894, ex parte), which Railliet believed was identical with *G. scutatum*, is reëstablished as a distinct species. It was found by Giles in India in the epithelium of the stomach of sheep and of the zebu.

The other forms mentioned are *G. musculi* (Rud., 1819) from the mouse (*Mus musculus*); *G. filiforme* Molin, 1857, from *Inuus ecaudatus; G. spirale* Molin, 1857, from *Cervus dama;* and *G. ursi* (Rudolphi, 1819) from *Ursus arctos.*

Neumann's original observations are confined to the species from domesticated animals.—C. W. STILES.

A bibliography, history, etc., of Italian helminthology, C. PARONA (*Atti R. Univ. Genova, 13 (1894), pp. 733, map 1*).—This elaborate work by Parona is divided into four parts: (1) The history of helminthology in Italy; (2) the parasites treated systematically, with cross references to the literature under each group, and a compendium of species arranged according to their hosts; (3) the geographical distribution of the various parasites in Italy; and (4) an almost complete bibliography of Italian works on helminthology, a short abstract of each paper being

given. The map gives the geographical distribution of the parasites of man in Italy.

This work represents years of hard labor on the part of Parona, and is one which is absolutely indispensable to all original workers in helminthology.—C. W. STILES.

A test of serum from tuberculous animals as a diagnostic agent for tuberculosis, EBER (*Ztschr. Fleisch- und Milch Hyg., 5 (1895), No. 5, pp. 91, 92*).—No reaction resulted after the serum was employed.

The teeth of the horse, W. G. RIDEWOOD (*Nat. Sci., 6 (1895), No. 38, pp. 249–258, figs. 2*).

DAIRYING.

The composition and analysis of milk and milk products, H. D. RICHMOND (*Analyst, 20 (1895), Mar., pp. 54–56*).—A report on the work done during 1894 in the laboratory of the Aylesbury Dairy Company. The results of analyses of 28,455 samples of milk are summarized by months. The average for the year was 1.0322 sp. gr., 12.67 per cent solids, 3.86 per cent fat, and 8.81 per cent solids-not-fat. "As is usual, the poorest milk is found in the summer and the maximum is attained in November."

The 2,269 samples of cream tested showed an average for the year of 48.9 per cent of fat. The average for 44 samples of clotted cream was: Water 31.59, fat 60.25, solids-not-fat 8.16, and ash 0.69 per cent.

The composition of the 174 samples of butter from different countries was as follows:

Composition of butter as sold in England.

	Water.	Fat.	Solids-not-fat.	Salt.	Ratio of water to solids-not-fat less salt.
French butter, fresh (41 samples):	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	
Highest	14.32	86.08	2.47	0.19	....
Lowest	12.78	84.19	.78	.03	....
Average	13.60	85.05	1.35	.09	9.2
French butter, salted (31 samples):					
Highest	13.57	87.72	4.63	3.29	....
Lowest	9.68	82.98	1.96	.57	....
Average	11.27	85.28	3.45	1.97	13.1
Brittany butter (6 samples):					
Highest	14.81	84.36	2.01	.25	....
Lowest	13.75	83.18	1.78	.09	....
Average	14.26	83.84	1.90	.16	12.2
English butter, fresh (22 samples):					
Highest	15.23	87.62	1.83	1.07	....
Lowest	11.90	84.03	.48	.01	....
Average	13.49	85.70	.81	.14	5.0
English butter, salted (46 samples):					
Highest	16.39	87.65	5.16	4.30	....
Lowest	10.19	79.99	1.90	.90	....
Average	13.11	83.94	2.95	2.11	6.4
Australian and New Zealand butter (6 samples):					
Highest	12.53	89.82	2.59	1.55	....
Lowest	8.24	85.41	1.44	.92	....
Average	10.72	87.21	2.07	1.23	7.9

The analysis is given of the fat of several samples. Analysis of a sample of salted butter when first made and after keeping in a cask for 1 month showed that the percentage of water had diminished from 15.24

when fresh to 11.08, and the salt from 3.96 to 2.61, the conclusion being that the water had run out rather than evaporated.

A contribution to the study of the ash of cheese, G. MARIANI and E. TASSELLI (*Staz. Sper. Agr. Ital., 28 (1895), No. 1, pp. 23–26*).—Analyses of the ash of 15 samples of cheese made by different methods are tabulated. The ash of 2 samples gave slightly alkaline reaction, that of all other samples being neutral.

In all samples there was less lime than phosphoric acid, the percentage of phosphoric acid being from 1.07 to 1.75 times that of the lime.

Edam cheese with 77.984 per cent of dry matter contained 5.798 per cent of ash. The percentage of chlorin was 1.591, equivalent to 2.624 per cent of sodium chlorid. The percentage of calcium oxid was 0.787 per cent, and of phosphoric acid 1.38 per cent, the ratio between the two being 1:1.75.

Cheese made from separator skim milk contained 55.243 per cent of dry matter, 7.473 per cent of ash, 2.154 per cent of chlorin (equivalent to 3.553 per cent of sodium chlorid), 1.102 per cent of calcium chlorid, and 1.845 per cent of phosphoric acid, the ratio between the last two being 1:1.67.

The composition of milk and the conditions affecting it, as shown by Bell's analyses, J. F. LIVERSEEGE (*Analyst, 20 (1895), Jan., pp. 7–12*).—The author discusses the analyses of the milk of 273 cows and 55 herds with reference to the milk standard of the English Society of Public Analysts, and with reference to the effect of breed, time of milking, and food on the composition of the milk.

"These analyses show that—

"(1) With 4 very slight exceptions, all the mixed milks are up to the society's standard [8.5 per cent solids-not-fat and 3 per cent fat].

"(2) Only 4 per cent of the milk from the single cows would show signs of much adulteration, as judged by the society's standard, if allowance is made for excess of the other constituents.

"(3) Analyses by the Bell method may give from 0.40 less to 0.26 per cent more than the calculated figures.

"(4) The longer the time between milking the lower will be the fat in milk.

"(5) With the exception of breed, the other conditions have much less effect on the proportion of poor milks."

Note on Recknagel's phenomenon, H. D. RICHMOND (*Analyst, 20 (1895), Jan., pp. 1–3*).—Recknagel, and later Vieth and other chemists, observed that the specific gravity of milk immediately after milking was lower than after standing some time. This Recknagel attributed to a swelling of the casein. The author reviews the subject and refers to some preliminary experiments without giving any details.

"It seems probable that Recknagel's explanation that a change in the casein occurs is correct, and that this is due to an enzyme (possibly the enzyme which causes the changes within the udder); it would appear from this that milk is still a living tissue after secretion. It is probable, then, that fore-milk (*i. e.*, milk that has remained ready formed for some time within the udder) will show much less rise than the later portions (which are drawn away as secreted). Preliminary experiments have shown indications of this being the case."

Investigations of the fat content of milk from individual cows, L. HANSEN (*Ugeskr. Landm., 40 (1895), pp. 25-27*).—The author determined the yield of milk, and the percentage of cream in the milk as shown by Fjord's control centrifuge, in case of 6 different herds for a period of 3 years, with the following average results per year:

Average annual record for 6 herds of cows.

Herd number.	Number of cows.	Average annual milk yield per cow.	Average cream content.	Corresponding to fat.
		Pounds.	*Per cent.*	*Per cent.*
1	18	5,867	5.1	3.6
2	16	5,500	5.0	3.5
3	13	5,500	5.1	3.6
4	14	5,867	4.6	3.2
5	11	4,767	4.6	3.2
6	4	5,133	4.4	3.1

Herd No. 1, giving the largest average yield of milk, produced the richest milk, or at least as rich milk as herd No. 3, which yielded 1,100 lbs. less milk per head during the 3 years considered. All herds were well fed and cared for, and most likely of the same breed, viz, the ordinary Danish red breed of milch cows. A detailed statement of the average cost of production of 1 lb. of butter in case of 36 cows is given, the amount of milk, butter, and skim milk and their value, as well as the cost of the feed eaten being noted in each case; the period considered is 1 year. The yields of milk ranged from 3,788 to 10,068 lbs.; of butter, from 121.9 to 394.8 lbs.; and the cost of producing 1 lb. of butter from 12.9 to 30.5 cents.—F. W. WOLL.

Churning experiments, J. L. HILLS (*Vermont Sta. Rpt. 1893, pp. 100-106*).

Sweet and ripened cream (pp. 101, 102).—The results are summarized for 33 churnings of sweet cream and 81 of sour cream as follows:

Results of churning sweet and ripened cream.

Condition of churning.	Number of churnings.	Milk taken as cream.[1]	Fat in buttermilk.	Fat in butter.	Curd in butter.	Temperature of churning.	Time of churning.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Deg. F.*	*Minutes.*
Sweet	33	16.8	0.36	81.93	0.66	57	34
Ripened	81	15.1	.24	82.05	.73	57	27

[1] This heading refers to the proportion of the weight of the cream to the weight of the milk from which it was obtained.

The sweet cream butters included 5 made by the butter extractor with an average of 80.03 per cent of fat. The sweet cream butter contained no more curd in these experiments than the ripened cream butter.

"At the same average temperature of churning, the sweet cream took a quarter as long again to churn and lost half as much again of fat in the buttermilk. This may be due in part to the fact that the sweet cream was less concentrated than the ripened cream."

Deep setting and separator cream (p. 102).—A series of 18 churnings with Cooley cream and separator cream, all made by the same butter maker, gave the following average results:

Churning Cooley and separator cream.

Separator.	Number of churnings.	Milk taken as cream.[1]	Fat in buttermilk.	Fat in butter.	Curd in butter.	Temperature of churning.	Time of churning.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Deg. F.*	*Minutes.*
Cooley cream	10	19.9	0.43	80.70	0.66	60	39
Separator cream	8	16.7	.46	82.16	.57	59	35

[1] This heading refers to the proportion of the weight of the cream to the weight of the milk from which it was obtained.

Some of these churnings were made during the summer, which accounts for the high percentage of fat in the buttermilk.

"Both creams were thin, the deep setting cream containing practically one fifth of the milk. There was little difference in time or temperature of churning. The butter made from the deep setting process, however, contained the least fat and the most curd."

Varying concentration of cream (pp. 102, 103).—The results of 110 churnings of cream of different thickness are summarized in the following table:

Churning thick and thin cream.

	Relation of cream to milk from which obtained, by weight.	Number of churnings.	Acidity.[1]	Fat in buttermilk.	Fat in butter.	Curd in butter.	Temperature of churning.	Time of churning.
	Per cent.			*Per cent.*	*Per cent.*	*Per cent.*	*Deg. F.*	*Minutes.*
Very thick	10 to 11.9	6	31.0	0.21	81.73	....	56	14
Thick	12 to 13.9	20	31.0	.23	82.78	....	55	24
Medium	14 to 15.9	35	33.0	.17	82.47	0.67	56	28
Thin	16 to 17.9	27	34.5	.33	82.30	.59	56	30
Very thin	18 to 21	20	35.0	.35	81.03	.66	58	34
Exceedingly thin	32.1	2	49.0	.35	81.82	....	56	68
Thick and medium, average	10 to 15.9	61	32.0	.19	82.50	....	56	25
Thin, average	16 to 32.1	49	35.0	.34	81.88	....	57	33

[1] Expressed in cubic centimeters of tenth normal alkali needed to neutralize 50 cc. of cream.

"Under conditions where there is body enough of cream to ripen well, regardless of concentration, it is probably safe to say that the thicker the cream the better, inasmuch as skimming is as satisfactory, the completeness and time of churning, and quality of the butter is better, a larger proportion of skim milk is delivered to the patron, and vat and churn room and handling are saved."

Varying temperatures of churning (pp. 103, 104).—The results are tabulated for 101 churnings at temperatures varying from 49 to 68° F. At temperatures below 56° F. the average percentage of fat in the buttermilk was 0.17, and the average time of churning 32 minutes; and at temperatures above 56° the average percentage of fat in the buttermilk was 0.33, and the average time of churning 23 minutes.

"A study of the table shows a connection between churning temperature and the results of churning. As the temperature rises, the loss of fat in the buttermilk increases, the cream becomes thinner, the percentage of fat in the butter decreases, and the time of churning shortens. There is no apparent effect upon the percentage of curd in the butter. These points indicate that the proper answer to the often-asked question regarding the temperature of churning is: Churn at the lowest temperature which under the individual conditions will produce exhaustive churning and make a good quality of butter in a reasonable time."

Varying acidities of cream (pp. 104, 105.)—The acidity was determined by Mann's acid test. The results are summarized of 51 trials in which the acidity varied from 27 to 42 cc. decinormal alkali per 50 cc. of cream.

"The only effect of increasing acidity of the cream shown in the table is in the composition of the butter. This again may be due to a thinner cream."

Varying lengths of time in churning (pp. 105, 106).—The results of 91 trials are summarized in which the time of churning varied from 15 minutes or less to 1 hour or more.

"There seems to be no connection between acidity of the cream, the temperature of churning, the curd in the butter, and the time occupied in the operation. The longer churnings, however, were on the thinner creams and lower temperatures, which is in line with the results shown in the table. The effect of lower temperature appears to be to increase the percentage of fat in the butter; of thinner cream, to decrease it, and we find in this case but slight difference between the character of the butter made in less or more than 25 minutes. It is difficult to say which of the factors had the most influence in the slight difference."

Summary (p. 106).—

"(1) In these experiments the per cent of fat in the butter appears lessened by thinning the cream, by an increase in churning temperatures, by an increase in the acidity of the cream, by the lengthening of the time of churning, and by the change from a separator to a deep setting system. There was no marked difference in the fat percentages of sweet and sour cream butters.

"(2) The per cent of curd in butters did not appear to be affected by the length of time or the varying temperatures of churning. The sweet cream butters contained more curd than those made from sour cream, and the deep setting butters more than did the separator-made goods.

"(3) The churnings were most exhaustive with thick and ripened creams at low temperatures, while varying acidities, length of churning, and methods of cream separation showed little effect.

"(4) The conditions most favorable in these experiments to exhaustive churning of a firm (high percentage of fat) butter from separator cream, appeared to be, (1) a thick cream containing 10 to 16 per cent of the original milk; (2) ripened cream, unless churning at 54° or below; (3) a low churning temperature."

Swedish butter exhibitions during 1894, N. ENGSTRÖM (*Tidskr. Landtmän, 15 (1894), pp. 922–926*).—The 248 creameries participating in the Swedish butter exhibitions conducted at Malmö and Gothenburg during 1894 exhibited 880 tubs of butter in all. The average water content of all samples of butter was 13.87 per cent, the range being from 9.13 to 20.22 per cent; 659 samples, or 74.9 per cent, contained between 12 and 15 per cent of water; and only 36 samples, or 4.1 per cent, contained more than 16 per cent of water.—F. W. WOLL.

Manufacture of sweet curd cheese, T. L. HÆCKER (*Minnesota Sta. Bul. 35, pp. 104–128, figs. 7*).—Detailed directions are given for making Edam and Gouda cheese. Gouda cheese is believed to be the kind best adapted for the home dairy, since "(1) the milk is worked warm, fresh from the cow; (2) it requires less than 2 hours to do the work; (3) the cheese can be cured in a cellar or in any damp, cool place; (4) it is a good keeper; (5) it is nutritious and palatable." The data are given for 25 trials in making Edam cheese, 9 in making Gouda cheese, and 10 in making Emmenthaler or Swiss cheese. These data include the principal conditions of manufacture, and the composition of the milk, whey, and cheese, and in the case of Gouda and Swiss cheese the losses of solids and fat during manufacture.

In the manufacture of Edam cheese there was a loss in the whey of from 5.66 to 7.98 lbs. of solids per 100 lbs. of milk, and from 0.3 to 0.87 lb. of fat. In making Gouda cheese from 42.87 to 47.07 per cent of the solids in the milk and from 7.1 to 12.38 per cent of the fat in the milk were lost in the whey. In making Swiss cheese the loss of solids in the whey ranged from 46.97 to 59.93 per cent and the loss of fat from 16.44 to 20.5 per cent. The whey in making all 3 kinds of cheese frequently contained more than 0.5 per cent of fat. The fat content was especially large in that of the Swiss cheese, where it ranged from 0.74 to 1.01 per cent. In a number of cases whey from making Emmenthaler cheese was run through the separator and the cream ripened and churned. The butter thus obtained scored 91 or 92 points.

"Whey butter as usually made is a very low grade of goods, selling about on a par with the grade generally termed 'packing stock, poor,' which sells for 10 cts. when extra dairy butter sells at 20 cts. By running the whey through a separator and ripening the cream with good lactic ferment the quality of the butter can be improved 25 to 50 per cent."

Method of preventing mites in cheese, P. B. SEGELCKE (*Fifth Rpt. Danish State Agl. Councilors, 1893, pp. 125, 126*).—The author gives the following method for preventing mites in cheese: The ceiling, walls, floor, and shelving of the curing room are whitewashed several times until the mites are destroyed. The cheese is first placed in a brine bath for 24 hours, and then in the curing room for 14 days, during which time it is wiped off daily. After 14 days it is thoroughly scraped and washed in lime water, placed on shelves, and kept clean; if a layer of slimy mold should again appear, the cheese must again be scraped and washed with lime.—F. W. WOLL.

Miscellaneous notes on handling milk, J. L. HILLS (*Vermont Sta. Rpt. 1893, p. 111*).—To compare the losses in making butter from milk containing large and small fat globules, the milk of 2 groups of cows possessing these characteristics was creamed in cold deep setting, the cream ripened, and churned at 58° F. The percentages of fat in the skim milk, buttermilk, and butter and the mechanical losses are tabulated. "There was but one third the loss in the creaming of the

milk containing the larger globules, and in this case there was also less mechanical loss."

The results of creaming milk of cows in different stages of lactation in cold deep setting and by separator are given.

Tests of cream separators, H. P. ARMSBY, W. H. CALDWELL, and L. E. REBER (*Pennsylvania Sta. Bul. 27, pp. 23*).—Tests are reported of the De Laval Alpha Acme, De Laval Alpha Turbine, United States No. 3, and Standard Russian separators. In these tests the number of runs with each machine varied from 4 to 10. The completeness of the separation was determined by weighing and analyzing the milk used and the products obtained so as to keep a close check upon the results. The results of the tests are fully tabulated, together with results of tests made at Vermont and New York Cornell stations, and the results of estimation of the steam consumption of belt and turbine separators are given. The average completeness of separation was as follows:

	Per cent.
De Laval Alpha Acme	98.31
De Laval Alpha Turbine	99.23
United States No. 3	98.08
Standard Russian	97.10

"Under the conditions of our tests, the steam was used very wastefully. Our conditions, however, were not widely different from those of very many small creameries, where a comparatively small and cheap engine is employed for the purposes of the creamery solely. Under such conditions it would appear that simple determinations of the horsepower required to drive a separator are of no practical value to the creamery man, since they furnish no measure of the amount of fuel which he will actually have to burn to operate the machines. . . .

"The comparison of the steam consumption shows that under our conditions the turbine separators were more economical of steam than the belt separators. That is to say, while the turbine uses steam extravagantly, the small engine of the average creamery uses it still more extravagantly, and the introduction of a turbine is likely to result in a saving of fuel. . . .

"The conclusion would seem to be that in small plants where a separate engine must be used for the creamery work a turbine will give the best economy, but that there is a point in the size of the plant were the economy of the belt machine will come to exceed that of the turbine."

Tests of dairy apparatus, J. L. HILLS (*Vermont Sta. Rpt. 1893, pp. 92–100*).—The results are given of tests of a number of different kinds of separators, made in connection with the Vermont Dairy School, and the determination of the power required for running by means of a dynamometer. In most of these trials the cream was ripened and churned to butter. A record is given for the whole process of butter making. The average results with each kind of separator are shown in the following table:

Tests of separators.

Separator.	Number of runs.	Speed in revolutions per minute.	Amount of milk separated per hour.	Horsepower used to separate 1,000 lbs. of milk per hour.	Fat content of— Whole milk.	Skim milk.	Bowl slop.	Proportion of fat in whole milk recovered in butter. Theoretical.	Actual.
			Lbs.		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
De Laval Alpha Turbine	4	5,780	1,800	....	4.35	0.06	0.24	98.0	89.3
Jumbo	4	6,925	1,820	1.87	4.27	.21	.13	95.9	....
De Laval Alpha Acme Belt	4	5,550	1,106	.79	4.36	.09	1.65	97.4	90.1
Reid's Improved Danish	5	5,673	2,078	1.83	4.24	.17	.08	96.6	92.6
United States No. 1	3	7,022	1,911	1.37	4.18	.17	.11	96.1	92.8
United States No. 3	3	7,330	600	.61	4.31	.08	.48	....	....
Russian Steam	2	7,066	1,315	....	4.17	.17	.23	....	....
Columbia	2	7,200	285	....	4.49	.05	.15	....	....
De Laval Baby No. 2	1	....	282	....	4.28	.04	.45	....	....
De Laval Baby No. 3	1	6,000	585	....	4.20	.23	1.71	....	....
Victoria	1	6,000	366	....	4.20	.38	....	....	....

The results obtained in this trial are compiled with those obtained previously at this station and at other stations, giving the results of tests of 49 different separators.

Progress in dairying in the last 25 years, W. KIRCHNER (*Deut. landw. Presse, 21 (1894), No. 98, pp. 19, 20*).

Dairy industry in Ireland for 1894, R. GIBSON (*Dairy, 7 (1895), No. 74, p. 34*).

Note on the cause of the decline in quality of Schleswig-Holstein butter and the remedy, H. WEIGMANN (*Landw. Wochenbl. Schles. Holst., 45 (1895), No. 3, pp. 33–36; Molk. Ztg., 9 (1895), No. 4, pp. 46–48*).

Influence of food on the quality of butter, C. SCHINKE (*Braunschw. landw. Ztg., 63 (1895), No. 10, pp. 41, 42*).

By-products of milk: I. Skim milk; II. Skim milk cheese, F. RIGAUX (*Ind. Lait., 20 (1895), No. 3, pp. 17, 18; No. 4, pp. 25, 26*).

Treatment of cream during churning, G. GROTENFELT (*Ind. Lait., 19 (1894), No. 48, pp. 361, 362; No. 49, p. 390; Dairy World, 15 (1895), No. 2, pp. 3, 4*).

The dilution of milk; its control by an examination of the skim milk, LESCŒUR (*Ind. Lait., 19 (1894), No. 34, p. 270*).

Laws relating to milk, butter, cheese, and oleomargarin, (*Rpt. Dept. Agr. New York, 1894, pp. 727–744*).—A digest of the laws of the various States.

Tests of cream separators, F. SCHOTTE and B. MARTINY (*Mitt. deut. landw. Ges., 1895, No. 5, pp. 53–57*).

Modern processes of butter making, L. BOCHET (*Ind. Lait., 20 (1895), No. 12, pp. 89–92; No. 13, pp. 97–99*).

Coöperative creameries, T. L. HÆCKER (*Minnesota Sta. Bul. 35, pp 93–103*).—This article gives detailed directions for organizing and establishing coöperative creameries, copy of articles of agreement and by-laws, and two plans for creamery building and estimates of cost.

Butter faults (*Ind. Lait., 20 (1895), No. 2, pp. 9, 10*).

Relation of bacteria to cheese, G. GROTENFELT (*Ind. Lait., 19 (1894), No. 46, pp. 366, 367; No. 47, pp. 373, 374*).

Studies on rennet, L. BAURY (*Ind. Lait., 19 (1894), No. 44, pp. 349, 350; No. 45, pp. 357, 358*).

Rennet and similar ferments, R. PETERS (*Preisschrift Rostock, 1894; abs. in Jour. Chem. Soc. London, 68 (1894), Mar., p. 80*).

The manufacture of soft cheese, E. RIGAUX (*Ind. Lait., 19 (1894), No. 31, p. 246; No. 32, pp. 255, 265; No. 33, pp. 262, 263; No. 34, pp. 270, 271; No. 35, pp. 278, 279; No. 36, pp. 286, 287; No. 37, pp. 293, 294*).

TECHNOLOGY.

The heating power of Wyoming coal and oil, with a description of the bomb calorimeter, E. E. SLOSSON and L. C. COLBURN (*University of Wyoming Spec. Bul., Jan., 1895, pp. 32, fig. 1*).—Analyses and tests of the fuel value of 54 samples of Wyoming coal, and tests of fuel value of 2 samples of Texas coal, 1 of fat pine knots, 6 of petroleum, and 2 of asphalt are reported and discussed in some detail. The average results of the tests of Wyoming coals were as follows: Calories per gram 6,282, foot-pounds per pound of coal 8,779,000, pounds of water at 212° F. evaporated by 1 lb. of coal 11.7. In case of the petroleum the calories varied from 10,430 to 10,927, the foot-pounds from 14,571,000 to 15,204,000, and the pounds of water evaporated from 19.4 to 22.24. Mahler's calorimetric apparatus is illustrated and described and the principles and methods of calorimetry are explained.

Analyses of maple sugar, sirups, etc., J. L. HILLS and B. O. WHITE (*Vermont Sta. Rpt. 1893, p. 29*).—The percentages of sugar in 21 samples are reported.

Effect of deep and shallow tapping of maple trees (*Garden and Forest, 8 (1895), p. 150*).—Deep tapping gives a much greater flow than when tapped but an inch deep.

Report on experiments in wine making in 1893, E. KAYSER (*Bul. Min. Agr. France, 13 (1894), No 8, pp. 874–884*).

A contribution to the study of the utilization of the refuse of wine making, E. SILVA (*Staz. Sper. Agr. Ital., 28 (1895), No. 1, pp. 5–18*).

AGRICULTURAL ENGINEERING.

Farm drainage, C. L. NEWMAN (*Arkansas Sta. Bul. 32, pp. 33–54, fig. 1*).—A popular discussion of this subject under the following heads: Protection from surface washing (plant cover, hillside ditches, and terraces), and drainage of wet lands (indications of the need of drainage, open ditches, and underdrains or covered ditches), with an appendix describing a homemade terracing instrument.

The artesian wells of southern Wyoming, J. D. CONLEY (*Wyoming Sta. Rpt. 1894, pp. 87–122*).—A reprint of Bulletin 20 of the station (E. S. R., 6, p. 848).

The Harvey water motor, A. A. JOHNSON (*Wyoming Sta. Rpt. 1894, pp. 66–72, figs. 6*).—A reprint from Bulletin 18 of the station (E. S. R., 6, p. 346).

An electric plow, F. BRUTSCHKE (*Fühling's landw. Ztg., 44 (1895), No. 5, pp. 158–165, fig. 1*).

Plows, rollers, fertilizer distributors, and potato planters, RINGELMANN (*Jour. Agr. Prat., 59 (1895), No. 11, pp. 388–393, figs. 8*).—Descriptions of agricultural implements tested.

Heel scrape and scooter, R. L. BENNETT and G. B. IRBY (*Arkansas Sta. Bul. 31, pp. 28–31, fig. 1*).—This implement is described and the character of its work commended.

Agricultural implements, A. DEBAINS (*Les machines agricoles sur le terrain. Paris*).—Separate volumes treat of cultivators, seeders, and harvesting machines.

Proceedings of the Virginia Good Roads Convention held in Richmond, Virginia, October 18, 1894 (*U. S. Dept. Agr., Office of Road Inquiry Bul. 11, pp. 62, fig. 1*).—An account of the proceedings, giving text of remarks, addresses, and papers. Addresses were made by G. L. Christian, president of the Richmond Chamber of Commerce, and S. W. Corbin, president of the State Board of Agricul-

ture, and the following papers were read: "What our bad roads cost us," by C. Coleman; "How to produce the means to build good roads," by J. F. Jackson; "Our highways, their construction and maintenance," by C. E. Ashburner; "The use of convict labor on public roads," by J. Graham, jr.; "Country road bridges," by C. C. Wentworth; "Stone and shell roads," by D. C. Humphreys.

STATISTICS.

Report of the statistician (*U. S. Dept. Agr., Division of Statistics Rpt. 123, n. ser., pp. 58*).—The statistics given in this report relate to the number and value of farm animals in the different States, the cotton crop of 1894, live stock in Great Britain and Ireland, and the cotton crop of India for 1894. The report also contains notice of a French Congress on popular credit, notes on the wheat crop of Victoria (Australia), notes on foreign agriculture, and transportation rates.

Report of the statistician (*U. S. Dept. Agr., Division of Statistics Rpt. 124, n. ser., pp. 59–106*).—This report treats of the distribution and consumption of corn, the consumption of wheat per capita in the United States, the wheat crop of the world, prices of wheat since 1865, wholesale prices of principal agricultural products, report of European agents, and transportation rates.

Reports of director and of treasurer of Vermont Station (*Vermont Sta. Rpt. 1893, pp. 9–16*).—This includes the review of the work of the year by the director, list of bulletins published, and matter of general interest, together with the treasurer's report for the fiscal year ending June 30, 1893. In connection with a revision of the station mailing list by return postal cards which took place during the year, it is stated that "over 95 per cent of the cards were returned, and a large number of names of persons who had died or removed to unknown addresses were stricken from the list."

Report of Wyoming Station for 1894 (*Wyoming Sta. Rpt. 1894, pp. 138*).—This includes a report by the director on the work of the year; treasurer's report for the fiscal year ending June 30, 1894; and brief reports by the agriculturist and horticulturist, physicist, meteorologist, botanist, chemist, and geologist; together with reprints of the bulletins published during the year.

Remarks on the work of the Posen Experiment Station in 1894, M. GERLACH (*Landw. Centbl. Posen, 23 (1895), No. 8, pp. 44, 45*).

NOTES.

MASSACHUSETTS STATIONS.—The two stations in Massachusetts have been united under the name of the Hatch Experiment Station of the Massachusetts Agricultural College. President H. H. Goodell has been elected director pro tem. The reorganization will be completed at the June meeting of the board of control.

ASSOCIATION OF AMERICAN AGRICULTURAL COLLEGES AND EXPERIMENT STATIONS.—Notice has been issued that the next annual meeting of the Association will be held at Denver, Colorado, beginning July 16, 1895.

SOIL TESTS IN VIRGINIA.—At a meeting of the Virginia State Board of Agriculture, April 10, 1895, called for the purpose of arranging for soil tests in the State, a resolution was reported and approved authorizing the Commissioner of Agriculture, in conjunction with the Committee of Agricultural and Analytical Chemistry of the Board, to expend $500 for conducting fertilizer tests in four different sections of the State, comprising the tobacco, corn, grass, and truck lands, and $1,000 for a preliminary examination of the composition, texture, and relations to moisture and crops of the principal soils of the State, under the advice of the Chief of the Division of Agricultural Soils of this Department.

Four points were selected for experiment, as follows: For bright tobacco, Pittsylvania County, near Danville; for corn, Hanover or Goochland County; for trucks, the peninsula near Williamsburg; for grasses, Augusta County.

PERSONAL MENTION.—Dr. J. P. Lotsy, associate in botany at Johns Hopkins University, has accepted the directorship of the botanical gardens of Java.

Dr. A. Morgen, for several years first assistant at the Halle Station, has been appointed professor of agricultural chemistry and director of the experiment station at Hohenheim, Germany, to succeed Prof. Emil von Wolff, who has retired.

Dr. Th. Pfeiffer, chemist to the German Agricultural Society, and formerly connected with the Göttingen Station, under Henneberg, has been elected professor of agricultural chemistry in the University of Jena. He will be succeeded by Dr. J. H. Vogel.

EXPERIMENT STATION RECORD.

VOL. VI. No. 11.

Twenty-six years ago, through the activity of Dr. F. Nobbe, the experiment station for plant physiology connected with the Forestry Academy at Tharand, Germany, offered to assist the farmers in the selection and purchase of seed. The station received an annual grant of about $450 from the Agricultural Society of Dresden to aid in carrying on its work. This was the beginning of the seed control, which from that time until the present has steadily grown in extent and in usefulness, especially in European countries. Its history, present extent, methods of work, etc., are described in detail in an interesting paper by B. Jonsson[1] on the seed control stations of the world, which includes a very complete bibliography of the subject. According to this paper there are now 117 stations in active operation outside of the United States. The different countries are said to be represented as follows: Belgium 9 stations, Bulgaria 3, Denmark 1, England and Scotland 2, France 1, Holland 4, Italy 1, Norway 3, Portugal 3, Roumania 1, Russia 7, Spain 1, Switzerland 2, Germany 38, Hungary 6, Austria 14, Sweden 16, Brazil 1, Japan 1, and Java 3.

In 1877 29 seed control stations were established in Germany, 7 of which were devoted to seed control exclusively, while the rest were combined chemical and seed control stations. The first seed control station in Austria was established in 1870, in Denmark in 1871, in Belgium in 1875, and in Switzerland and Russia in 1876.

The organization and working plans of the different stations vary to suit the individual needs of the work, but the modified plans as suggested by Dr. Nobbe are the basis for all. The methods of the German stations have been fully described in this journal by Dr. Oscar Burchard (E. S. R., 4, pp. 793, 882). In all cases a certain definite sample is required, the size of which depends on the seed to be examined. For the smaller and lighter seeds 100 gm. is required, while for the larger seeds the weight of the average sample must be at least 250 gm. From these samples smaller ones are taken and tested for their purity, germinative ability, and intrinsic worth. The weight of these smaller samples varies from 2 gm. for the smaller and lighter seeds to 50 gm.

[1] Kgl. Landt. Akad. Handl. Tidskr., 33, pp. 257–286 and 321–372.

for such large seeds as corn, beans, beet seed, etc. The time for germination has been experimentally determined for the different kinds of seed and the germination in a certain definite time of every lot tested is compared with the standard for that kind. The standards for purity, germinative ability, and intrinsic worth vary in different countries, each having its own.

The methods by which the control is secured differ in different countries. In some countries this is brought about through legislative action requiring all seed offered for sale to be up to a certain definite quality. In others the same end is secured by a mutual agreement between the wholesale dealers and the stations, whereby dealers place themselves voluntarily under the control of the station and the station certifies to the quality of the seed placed on the market. In other cases there is a combination of these two methods of control, governmental supervision being provided for local dealers and either private or control contract for those outside the State's jurisdiction. Under the private contract the station has no connection with the consumer, but it simply reports to the wholesale dealer on the qualitity of the seed. Under what is known as the control contract the station certifies to the quality of seed and a copy of this certificate is furnished to every purchaser. Under certain conditions the consumer is allowed a free reëxamination of any seed purchased under the control contract, and if a departure of more than 5 per cent from the guaranty is found the dealer is required to reimburse him.

The first attempt in the United States in seed testing was made at the Connecticut State Station in 1877, and two years later the North Carolina Station equipped itself for such work. At the present time several of the experiment stations are prepared to test samples of seed sent them, but they exert no control over their sale. Systematic effort was commenced by this Department about a year ago to collect information on the commercial side of the seed industry in this country and to study the quality of the seed placed upon the market.

The benefits resulting from the seed control in Europe are apparent in the improvement of the quality of seed in general and in the security which it gives to the buyer. The reports of these stations show that the quality of seed has steadily improved since the introduction of seed control. This is especially true in regard to trueness to name and freedom from weed seeds.

The necessity for seed control in this country is not less than in Europe. It is second only in importance to the control of the sale of commercial fertilizers now exercised so generally in the States where fertilizers are used.

The following is a list of the seed control stations now in active operation in different countries, with the date of their establishment, taken from the article by Jonsson referred to above.

Belgium: Antwerp, Courtrai, Ghent (1875), Gembloux (1875), Hasselt (1878), Liege (1878), Louvain, Mons, Roulers.

Bulgaria: Rustchuk (1892), Sadova (1892), Plevna (1892).

Denmark: Copenhagen (1871).

England and Scotland: London, Edinburgh.

France: Paris (1884).

Holland: Goes (1889), Groningen (1889), Hoorn (1889), Wageningen (1877).

Italy: Modena (1890).

Norway: Hamar, Christiania, Frondhjem.

Portugal: Evora (1886), Lisbon (1886), Oporto (1886).

Roumania: Bucharest (1887).

Russia (including Finland): Helsingfors (1881), Riga (1876), St. Petersburg (1880), Sobieszyn (1892), Tver (1892), Warsaw (1880), Aabo (1881).

Spain: Madrid (1891).

Switzerland: Rüti (1876), Zurich (1876).

Germany: (1) *Prussia:* Arendsee (1879), Bonn (1881), Bremervorde (1876), Breslau (1875), Dahme (1876), Dantzic (1876), Ebstorf (1871), Eldena (1878), Göttingen (1876), Halle (1877), Hildesheim (1878), Insterburg (1877), Kempen (1883), Kiel (1874), Königsberg (1875), Köslin (1893), Marburg (1876), Münster (1871), Posen (1873), Wiesbaden (1881). (2) *Bavaria:* Augsburg, Baireuth (1876), Landshut (1876), Munich (1872), Speyer, Triesdorf (1876), Würzburg (1881). (3) *Saxony:* Tharand (1869). (4) *Baden:* Karlsruhe (1872). (5) *Hesse-Darmstadt:* Darmstadt (1871). (6) *Oldenburg:* Oldenburg (1876). (7) *Brunswick:* Brunswick (1877). (8) *Mecklenburg-Schwerin:* Rostock (1875). (9) *Saxe-Weimar:* Jena. (10) *Alsace-Lorraine:* Rufach (1874). (11) *Bremen:* Bremen (1877). (12) *Hamburg:* Hamburg (State) (1891), Hamburg (private) 1891.

Hungary: Budapest (1882), Debreczin, Keszthely, Kassa, Kolosmonostor, Altenberg (1878).

Austria: Czernislov, Dublany, Feldkirch (1876), Grätz (1872), Kaaden (1877) Neutitschein (1891), Oberhermsdorf, Prague (1877), Prerau (1884), St. Michele (1874), Tabor (1874), Troppau (1892), Vienna (State) (1870), Vienna (agricultural society) (1881).

Sweden: Borås, Falun, Gefle, Halmstad, Hernosand, Jönköping, Kalmar, Christianstad, Linköping, Luleå, Oerebro, Skara, Stockholm, Svalof, Upsala, Westerås.

Brazil: São Paulo (1887).

Japan: Tokyo (1893), with substations.

Java: Kagok-Tegal, Pasoeroean, Buitenzorg.

THE PHYSICAL PROPERTIES OF THE SOIL.[1]

Dr. Ewald Wollny.

PART 3.

IV. THE BEHAVIOR OF THE SOIL TOWARD AIR AND GASES.

THE AIR CAPACITY (OR POROSITY) OF THE SOIL.

This is expressed by the ratio of the volume of the air spaces to the total volume of the soil. The volume of the pores or intergranular spaces varies in natural soils, as we have already seen (p. 764) within wide limits—in the dry state from 20 to 85.3 per cent. In one and the same soil the air capacity depends principally on structural conditions. In the dry state the volume of the air spaces is greater the smaller the particles. Stirring and flocculation increase the volume of the pores generally to a considerable extent, while the pressing together of the soil produces the opposite result. It may be mentioned further that the quantity of air inclosed in a soil decreases as the proportion of stones increases.

With the increase in the quantity of water present the volume of the pores of course decreases, but to a varying extent according to the water capacity. In the moist state clay and humus contain the smallest quantity of air of any of the soil constituents; in fact the air may be entirely absent when these substances are saturated with water. The quantity of air in the wet mass always increases with the quantity of coarse-grained constituents. The influence of water on the volume of the pores is less marked in crumbly than in powdery soils, because in the former the noncapillary spaces are not filled with water. The decrease in the quantity of air due to an increase in the density of the mass is greater in the moist than in the dry condition.

From what has been said regarding the influence of the quantity of water in a soil on the volume of the pores it is plain that the quantity of air in the soil increases during drought and decreases correspondingly with an increased precipitation. The extent of the influence of the soil in this particular is determined by its mechanical structure.[2]

The air inclosed in the soil is seldom stagnant, but is generally in constant motion, causing an exchange of air between the atmosphere and the soil. This motion is due to the variations in atmospheric pressure, temperature, and wind movement.

[1] Continued from p. 863. [2] E. Wollny, Forsch. Geb. agr. Phys., 8, p. 371.

THE PERMEABILITY OF THE SOIL FOR AIR.

This property is measured by the quantities of air which pass through the soil, other conditions being the same. Except under special conditions it does not depend upon the volume of the pores, but is influenced primarily by the size of the pores, since the latter determines almost exclusively the resistance offered to the circulation of the air. The permeability necessarily increases as this resistance diminishes, and is therefore smaller the smaller the soil particles, and *vice versa.*

Of the different soil constituents in the dry state, clay is the least permeable to air; and permeability increases generally with the quantity of quartz present. Soils consisting of humus alone behave, when dry, similarly to the coarse-grained sands. In soils made up of constituents varying considerably from one another in the size of the particles, the permeability of the whole mass depends principally on the finest-grained material. The remarkable permeability of most sands can, therefore, be reduced considerably by the admixture of comparatively small quantities of some fine-grained material, such as clay, loam, or marl.

In the case of stratified soils the permeability depends entirely on the finest grained layer, even if the layer is very thin. In a very impermeable soil the permeability is increased to a remarkable extent by the formation of the crumbly structure. With an increase of humidity the permeability of a soil for air diminishes, and more strongly the greater the water capacity of the soil. All soils rich in clay and humus become impermeable at a point below saturation. Crumbly soils have their permeability affected to a very much less degree by an increase in humidity than soils having a separate grain structure. If a soil is wet only in the upper layers the entrance and exit of air is hindered in proportion to the fineness of the grains. In soils rich in clay and humus this may result in absolute impermeability, even with slight precipitation.

If air is forced by pressure through soil, the quantity of air passing is proportional to the pressure, and inversely proportional to the thickness of the layer, so long as the velocity does not exceed 0.05 meter. As soon as this limit is exceeded the volume of air does not diminish as the pressure diminishes or as the thickness of the layer increases, but to a less extent, and *vice versa.*[1]

THE DIFFUSION OF GASES FROM THE SOIL.

The pores of the soil contain, along with atmospheric air and water vapor, different gases, of which carbonic acid is the most important, as

[1] H. Fleck, Ztschr. Biol., 16, p. 42. Erster Jahresbericht der chemischen Centralstelle für öffentliche Gesundheitspflege in Dresden. F. Renk, Ztschr. Biol., 15. G. Ammon, Forsch. Geb. agr. Phys., 3, p. 209. D. von Welitschkowsky, Arch. Hyg., 11. R. Heinrich, Grundlagen der Beurtheilung der Ackerkrume, 1882, pp. 123, 221. E. Wollny, Forsch. Geb. agr. Phys., 16, p. 193.

it is present in the largest quantities. The carbonic acid is due principally to the decomposition of organic substances. The amount present depends upon the richness of the soil in humus and the rapidity of decomposition, but it is almost always much more abundant in the soil than in the atmosphere. Under these circumstances it is of interest to note that there is a constant movement in the soil atmosphere not due to external influences, but to diffusion, *i. e.*, the tendency for the external and internal gases to come into equilibrium.

The diffusion of the carbonic acid (as well as ammonia and other gases) from the soil at a constant temperature depends principally on the sum of the pores of the cross section and not on their size. Hence the absolute quantity of diffused gases is larger the greater the total volume of the pores, and *vice versa*. Every decrease in the volume of the pores, whether due to pressure or to an increase of moisture in the soil, is accompanied by a decrease in the quantity of gas diffused. The escape of carbonic acid into the atmosphere by diffusion decreases with the fineness of the grains of the soil, the compactness of their arrangement, and the greater the water capacity of the soil, and *vice versa*. The quantity of carbonic acid diffused diminishes as the thickness of the soil increases, but to a less extent. In soils which become superficially saturated, and into which water penetrates slowly, the diffusion of carbonic acid is considerably diminished or brought to a standstill.[1]

THE ABSORPTIVE CAPACITY (OR CONDENSATION CAPACITY) OF THE SOIL FOR GASES.

Absorption, in the widest sense of the word, is a molecular phenomenon and includes all those causes which bring about the retention of gas molecules on and in solid bodies. It is only a matter of custom to distinguish between hygroscopicity and gas absorption (absorption in the narrow sense), which are essentially identical phenomena. The retention of the gas molecules is caused by a series of separate processes. These are discussed below.

Surface attraction.—There are on the surface of all solid bodies molecular forces related to adhesion, which attract the nearest gas molecules to the surface of the solid body, and there force them together in a dense, partly liquid or perhaps solid envelope, until an equilibrium is reached which remains undisturbed until the constitution of the surrounding medium changes. This process takes place almost instantaneously and with great energy, so that in the beginning, at least, the whole process of absorption may be attributed to it. It also causes initially a rapid rise of the absorption curve and produces a considerable amount of heat, which gives the impetus to a series of further phenomena.

Molecular penetration.—The attracted gas particles penetrate to a certain extent into the intramolecular spaces of the solid body in much the

[1] F. Hannen, Forsch. Geb. agr. Phys., 15, p. 1.

same way as gases are absorbed by liquids, partly on account of the high pressure to which they are subjected and partly on account of the very fine capillaries. This process takes place more slowly than surface attraction, and ceases when the resistance opposed to the penetration of the gas molecules can no longer be overcome.

Absorption.—Owing to surface attraction, an exceedingly thin layer of liquid is very soon formed over the surface of the solid body, and this layer now absorbs gases. Assisted by the high pressure to which this layer is subjected (Bunsen estimates the pressure at hundreds of atmospheres) its capacity for absorption of gases rises to a degree far exceeding our ideas of such processes. This process may also continue for years before reaching its conclusion (Bunsen).

Chemical reactions.—Leaving out of account simple chemical attractions, which do not belong in the realm of gas absorption, there are widely varying, and under ordinary circumstances for the most part unknown, chemical activities between the molecules of the solid body and those of the penetrating gas. The high capillary pressure together with the disengagement of considerable quantities of heat during the initial condensation bring about and keep in action processes which chemical affinity alone would not cause.

The numerous investigations on this subject have given the following results: All the soil constituents have a not inconsiderable absorptive capacity, which is greatest in the case of humus (and ferric oxid), next highest in clay, and least in quartz. Mixed soils behave as their individual constituents. The absorptive capacity increases in any case with the fineness of the particles, and decreases with a rise of temperature. In the absorption of water vapor from air saturated with moisture the latter law is modified only to the extent that the absolute quantity of water increases with the temperature; in which case the influence of the rise in temperature is almost eliminated by the increase in humidity. If the absolute humidity of the air is constant while the temperature rises the influence is the same as that observed in the case of gas absorption. At a constant temperature the hygroscopicity increases with the relative humidity of the air. If the soil is more than hygroscopically moist the gas absorption we have so far considered is replaced by the absorption of gases in the soil water. Rising temperatures accelerate the condensation process. Gases are in general more easily absorbed the more readily they alter their molecular arrangement and the more easily they decompose.[1]

The significance of the absorptive capacity in relation to the fertility of the soil is often overestimated. Gases capable of increasing the supply of fertilizing material occur only in very minute quantity in the atmosphere or in the soil air. The absorption of oxygen is of most importance, because it is through this means that the soil is capable of

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[1] G. Ammon, Forsch. Geb. agr. Phys., 2, p. 1. A. von Dobeneck, Ibid., p. 163. Both these articles contain a complete general review of the copious literature on this subject.

supplying the oxygen necessary for the respiration of the plant roots when the supply from the atmosphere is cut off by excessive moisture. The hygroscopic water, which occurs to a considerable extent in many soils, is also of comparatively slight importance for vegetation, because the plants wilt before the quantity of water has fallen sufficiently to make it possible for an absorption of water vapor to take place at all.

THE COMPOSITION OF THE SOIL ATMOSPHERE.

The air inclosed in the soil differs from atmospheric air principally in containing more carbonic acid, less oxygen, and more moisture. From the well-established fact that the soil atmosphere becomes richer in carbonic acid in proportion to the diminution of its oxygen, in such a way that the volume of carbonic acid and oxygen together remains constant, we must infer that the carbonic acid is the product of processes of oxidation. Of the latter the most important are those connected with the decomposition of organic substances in the soil.

The quantity of carbonic acid in the soil air, which is always greater than that in the atmospheric air, sometimes several hundred times as great, is subject to great variations, which are due (1) to a variation in the quantity of organic matter in the soil, (2) to fluctuation in the rapidity of decomposition, and (3) to differences in the processes by which the carbonic acid can leave the soil.

Concerning the first of these reasons, investigations have shown that the quantity of free carbonic acid is proportional to that of the organic matter only when the latter is small, but that the ratio of carbonic acid to organic matter diminishes when the latter is great. The quantity of carbonic acid may remain constant when that of the organic matter varies, since a high proportion of carbonic acid in the soil air diminishes the activity of the lower organisms taking part in the processes of decay, so that with an increase of organic matter the conditions for decay become less favorable.

The degree of decomposition of the organic substances, and consequently the proportion of carbonic acid, depends principally upon the access of air, moisture, and warmth. The quantity of free carbonic acid increases, other conditions being the same, with the supply of oxygen, up to a certain low limit. This increase, however, is not directly proportional, but is progressive at first, and after passing a certain limit is less than that of the supply of oxygen. The decomposition of organic matter, and hence the production of carbonic acid, rises and falls with the quantity of water in the soil, so long as the access of air is not prevented beyond a certain limit. With an increase in temperature up to about 50° C. the intensity of the decomposition of organic matter and of the production of carbonic acid increases. The resultant action of the above-mentioned factors depends on the fact that the extent of the production of carbonic acid is determined by the minimum factor. From this it follows that the quantity of free carbonic acid, the proportion of organic matter remaining constant, is very

variable, depending on the physical structure of the soil, its covering, and on the meteorological conditions. In the case of varying quantities of organic matter, its influence on the quantity of carbonic acid may be diminished or entirely eliminated if the more important factors of decomposition (water and temperature) act in the reverse direction. Further than those already given, general laws to account for the very wide variations mentioned can not be framed. In individual instances the local influences alone decide the result.

In conclusion we may note that carbonic acid can pass out from those strata where it is most copiously produced into layers above and below. Its penetration into lower layers and its escape into the atmosphere probably account for the fact that the proportion of carbonic acid is generally greater in the lower layers of the soil. The sinking of carbonic acid into lower layers and its escape into the atmosphere depend essentially on the physical structure of the soil as a whole and of its separate strata, in that the accumulation of the gas in the pores of the soil is promoted by fineness of grain structure and an increase of humidity, and *vice versa*. The influence of the quantity of organic matter and of the external factors of decomposition on the proportion of carbonic acid in the soil air may, therefore, under certain circumstances, be marked by variations in permeability. Thus a coarse-grained sandy soil, rich in humus, may contain less carbonic acid than a fine-grained soil poor in humus, because in the former case the gas will be given off to the atmosphere very much more quickly than in the latter. Such facts, in conjunction with those already adduced, justify the conclusion that the quantity of free carbonic acid in the soil does not show the intensity of the organic processes nor the quantity of organic matter in the soil.[1]

V. THE BEHAVIOR OF THE SOIL TOWARD HEAT.

As the sources of heat for the soil we must consider the heat of the sun, the heat due to chemical action and absorption of gases, and the internal heat of the earth. The heat of the sun is of primary importance, while the other factors have very slight influence.

The heat resulting from the oxidation of organic matter (decay, slow combustion) is, as a rule, insufficient to cause any considerable rise in

[1] Boussingault and Lévy, Ann. Chim. et Phys., ser. 3, 37 (1853), p. 1. J. von Todor, Hygienische Untersuchungen über Luft, Boden und Wasser, 1892, 2, p. 106; Vierteljahresschrift für öffentliche Gesundheitspflege, 7, p. 205. M. von Pettenkofer, Ztschr. Biol., 7, 9, 12. G. Wolffhiegel, Ibid., 15. P. Smolenski, Ibid., 13, p. 383. H. Fleck, Jahresbericht der chemischen Centralstelle für öffentliche Gesundheitspflege in Dresden, 2, p. 15; 3, p. 3. Lewis and Cunningham, Ann. Rpt. Sanitary Commission, Government of India, 1874. R. Nichols, Ann. Rpt. Mass. State Bd. Health, 1875, and Rpt. Sewerage Commission, Boston, 1876. E. Ebermayer, Forsch. Geb. agr. Phys., 1, p. 158; Ibid., 13, p. 15. F. Möller, Mittheilung aus dem forstlichen Versuchswesen Oesterreichs, 1, p. 121; Forsch. Geb. agr. Phys., 2, p. 329. E. Wollny, Vierteljahresschrift für öffentliche Gesundheitspflege, 1883; Landw. Vers. Stat., 25 and 36; Jour. Landw., 34 (1886), p. 213; Forsch. Geb. agr. Phys., 3, p. 1; 4, p. 1; 5, p. 299; and 9, p. 165.

the soil temperature. It has been found, however, that with the incorporation of organic manure into cultivated soils the rise in temperature, other things being equal, is proportional to the quantity of manure and (within certain limits) the amount of heat produced by the decomposition of the manure is proportional to the initial temperature and humidity of the soil. The greater the chemical tension and the larger the amount of easily decomposable compounds (especially those containing nitrogen) present in the material applied, the greater the amount of the heat produced, if the porosity and temperature (over 10° C.) are favorable. For these reasons the most energetic liberation of heat takes place, as a rule, immediately after the introduction of stable manure or undecomposed vegetable matter. This persists for a period dependent upon the favorableness or unfavorableness of the external conditions and the quantity and nature of the organic material, and diminishes by degrees until the temperature of the manured and unmanured soil has become the same.

The warming effect of the above-mentioned manures lasts from 4 to 12 weeks and amounts to 0.1 to 0.4° on an average, though only when comparatively large quantities of readily decomposable material are used and the circumstances are favorable to decomposition. From these data, and also from the fact that in most cases the amount of heat produced by the quantities of manure ordinarily used or by the decomposition of the humus already present in the soil is scarcely appreciable, it may be assumed that the source of heat in question is of subordinate significance.[1]

Of still less importance is the liberation of heat on the addition of water, or the absorption of gases and water vapor by the soil, inasmuch as the effect thus produced is of only short duration and seldom occurs under natural conditions, since the conditions are not often favorable to condensation.[2]

Very little of the internal heat of the earth is communicated to the soil, owing to the poor conductivity of the earth's crust, and the effect is approximately the same for all soils.

From the above facts it follows that the marked differences observed in the temperature of the soil are brought about only by the heat of the sun, since other sources of heat than those already mentioned do not exist. The effects of the sun's heat are modified principally by (1) the physical structure of the soil, (2) the covering, (3) the position of the soil, and (4) the course of the meteorological elements.

INFLUENCE OF THE PHYSICAL STRUCTURE OF THE SOIL.

For a proper understanding of the rather complicated phenomena connected with the warming of the soil it is necessary to consider separately the different factors concerned.

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[1] F. Wagner, Forsch. Geb. agr. Phys., 5, p. 373.

[2] A. Stellwaag, Ibid., p. 210. J. Breitenlohner, Ibid., 7, p. 208.

The absorptive capacity and emission capacity of the soil for heat rays.—No experiments are recorded regarding the absorptive capacity of the soil for the true heat rays (invisible ultra-red) of the solar spectrum, but the absorption of the visible rays depends on the color of the soil. Assuming the behavior of the dark heat rays to be the same as that of the luminous rays, we can say that the darker the color the more the soil is warmed. The absorption of the luminous rays is of importance, because the proportion between luminous and non-luminous rays is nearly constant in sunlight, the invisible radiation amounting to only twice the visible radiation.

The color of the soil tells us nothing concerning the emission capacity for heat rays. Kirchhoff's law states that the ratio of emission to absorption is the same in all bodies, but only for rays of the same wave length at the same temperature. Soils when exposed to the sun absorb a mixture of rays of every degree of frangibility and temperature, but emit only rays of slight refrangibility (dark rays) and low temperature; therefore the rays absorbed are different from those emitted. From this it follows that emission can not be directly estimated from absorption. So far as we can generalize the results of experiments thus far made along this line, it may be said that the mineral constituents radiate heat better than the organic, and that of the former quartz radiates most perfectly. In natural soils, which generally consist of a mixture of constituents, the differences in radiation capacity are very small. Water radiates heat rays to a greater extent than any of the solid constitutents of the soil. Therefore when much moisture is present the differences which would otherwise occur in the emission of heat disappear almost entirely.[1]

The heat absorbed in evaporation at the surface of the soil.—The heat of the sun absorbed by the soil is lost partly by being communicated to and warming the lower strata of soil, and partly by being rendered latent by evaporation. Loss of heat in the second way increases and decreases, other things being equal, with the quantity of evaporation.

The heat capacity (specific heat) of the soil.—This property, like the water capacity, is most conveniently referred to the volume, and is expressed by the number of units of heat necessary to raise the temperature of a definite volume of the soil 1°, compared with the number required to raise the same volume of water the same interval of temperature, this number in the case of water being considered as unity. The specific heat of the soil in the dry state amounts to one sixth to one third that of water. Of the various soil constituents, quartz has the highest specific heat (0.2919), humus the lowest (0.1647), while clay is intermediate (0.2333). With an increase of water in the soil, the specific heat of course increases; therefore in one and the same soil the

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[1] A. von Liebenberg, Untersuchungen über Bodenwärme; Habilitationsschrift, Halle, 1875. C. Lang, Forsch. Geb. agr. Phys., 1, p. 379. E. Wollny, Ibid., p. 43; 4, p. 327. J. Ahr, Ibid., 8, p. 397.

specific heat is higher in proportion to the absorptive capacity for water vapor and to the water capacity, and *vice versa*. For this reason the specific heat is greatest in humus, less in clay, and least in quartz, when the relative saturation with water is the same. In soils containing much water the specific heat is greatest when the particles are fine and compactly arranged. The specific heat is also smaller in soils with crumbly structure than in those having separate grain structure, other things being equal.[1]

The conductivity of the soil for heat.—The temperature of the uppermost layer of the soil is communicated by conduction to the lower layers. The temperatures in the upper and lower layers tend to equalize themselves, but for this a certain length of time is of course required. This circumstance explains a number of phenomena noticed in studying the thermal conditions of the soil.

There is both an upward and downward movement of heat, and it is slowest in humus, quickest in quartz sand, and has an intermediate velocity in clay. Carbonate of lime and ferric oxid have a conductivity for heat intermediate between clay and quartz. In one and the same soil in the dry state the conduction of heat generally increases with an increase in the size of the particles and aggregates. Conduction increases with the proportion of stones and with the compactness of arrangement of the particles. The differences also increase, as a rule, with the quantity of water in the soil. Water increases the conductivity of a soil very considerably, and in proportion to the quantity present, other things being equal.[2]

The soil temperature observed under any given circumstances depends, in as far as it is affected by the mechanical structure of the soil, on the resultant action of all the factors just described. The causes attributable to the soil itself bear such a varied relationship to one another that no satisfactory explanation can be arrived at from average figures for observations covering long periods of time as to the individual factors in different soils. Only the variations in different periods with varying external temperature can be decided. This might be inferred from the fact that, under the same external circumstances, different kinds of soil, in spite of their very different behavior toward variations in heat, show the same yearly average, or differences of only a few tenths of a degree. This is explicable when we bear in mind that differences occurring in separate periods are of such

[1] W. Schumacher, Physik des Bodens, p. 242. L. Pflandler, Poggendorff's Annalen, 129, p. 102. H. Platter, Annalen der Landwirthschaft in Preussen, Monatsblatt, 1870, No. 52, p. 52. A. von Liebenberg, Untersuchungen über die Bodenwärme, Habilitationsschrift, Halle, 1875. C. Lang, Forsch. Geb. agr. Phys., 1, p. 109. R. Ulrich, Ibid., 8, p. 1.

[2] F. Haberlandt, Wissenschaftlich-praktische Untersuchungen auf dem Gebiete des Pflanzenbaues, 1, 1875. A. von Littrow, Sitzungsberichte der kaiserl. Akademie der Wissenschaften in Wien, 1875, 61, pt. 2. E. Pott, Landw. Vers. Stat., 22. F. Wagner, Forsch. Geb. agr. Phys., 6, p. 1.

a nature as to counterbalance one another. The thermal conditions can therefore be clearly determined only by taking into consideration the course of the soil temperature.

With a rising temperature (during exposure to sunlight by day or during warm seasons) quartz warms up most strongly of any of the soil constituents, then follow in order clay, chalk, and humus. With a falling temperature (during the night or during cold seasons) the heat conditions are exactly the reverse, inasmuch as quartz cools most quickly, humus most slowly, while clay and chalk are intermediate. The reasons for this are to be found principally in the differences in specific heat of the various constituents in the moist state and in their conductivity for heat, as described above.

In soil of the same constitution the warming depends on the nature of the surface, and the size and arrangement of the particles, as well as on the humidity.

With regard to the influence of the nature of the surface we may mention first that drying up of the top layer induces a rise in the soil temperature owing to a reduction in the evaporation throughout the mass but especially at the surface. The superposition of thin layers of a soil which easily dries up (quartz sand) has the same result. If the upper layers of the soil are stirred the temperature is lowered, because the conductivity of the dry layer, owing to the large quantity of inclosed air, is diminished and the fragments lying on top are only partially in contact with the soil below for purposes of conduction. The constitution of the soil being the same, the color has a decided influence down to comparatively great depths. During the warmer seasons, when the radiation is unhindred, the dark-colored soils are warmer. The differences in temperature in dark and light colored soils disappear more or less during colder seasons when the exposure to the sun is imperfect. This influence of color diminishes as the humidity increases, and as the other factors controlling the warming of the soil obtain preponderance. Under greater differences in the physical properties, especially those due to a higher proportion of humus and to a larger capacity for water, the influence of color may be entirely eliminated.

Regarding the warming of the soil as affected by differences in structure, it has been observed that the soil warms up during the summer and cools down during winter more strongly when the structure is coarse. The principal reason of this is that with an increase in the diameter of the particles are connected a decrease in the quantity of water and an increase in conductivity. Crumbly soils are, as a rule, warmer than powdery, but the differences are comparatively slight. On the other hand, an increase in density of the mass of the soil has a very important influence on its temperature, in that an increase of density causes a higher temperature during warmer seasons or with a rising temperature and a lower temperature during colder seasons or with a

falling temperature. This difference may be explained by the fact that by the compacting of the soil its conductivity is increased, and to such an extent that the accompanying increased absorption of heat due to evaporation is for the most part eliminated. The presence of stones in the soil results in a greater capacity for heat in consequence of increased conductivity. At the same time a stony soil cools more rapidly than one free from stones when the temperature falls.

The heat conditions of the soil are dependent to quite a remarkable extent on the quantity of water present. During the warm season the temperature of the soil is generally lower when much water is present, because as the absorption of heat by evaporation increases the specific heat also increases. These differences in temperature are the smaller the more the evaporation diminishes and the increased conductivity due to greater humidity can exert its influence. They are, therefore, during the cold season smallest when the exposure to the sun's rays is slight, the air cool, and still the humidity of the air high and the top layer of soil dry. The effect of cooling due to evaporation, external conditions being the same, is the more easily eliminated and counterbalanced the less water the soil contains, the smaller its water capacity, and the more slowly it replaces by capillarity the loss of water from the surface. With regard to differences in temperature of wet and moist soils (maximum 1 to 1.5° C.), it seems unjustifiable to attribute the low productiveness of wet soils to their lower temperature.

In the freezing of water in the soil the phenomenon of supercooling may be noticed. The soil water, under the influence of capillary tension, becomes cooled by frost below its real freezing point without solidifying, but as soon as any impulse is given to its solidification it passes at once into the form of ice. The heat liberated by this change is sufficient to keep the soil at 0° C. until this heat is used up and the temperature of the soil gradually comes into equilibrium with the lower surrounding temperature. The supercooling temperature of soil water seems to be lower as the humidity decreases and as the energy with which the water is held by the soil increases. During continued frost the temperature of the soil falls faster and lower the less the humidity of the soil. Afterwards the differences in the temperature tend to disappear, or are, under certain circumstances, reversed.

The penetration of frost takes place most quickly in quartz sand, more slowly in clay, and most slowly of all in humus. When the soil thaws out its temperature first rises to 0°, and remains constant for some time before it undergoes a further rise in temperature. Thawing takes place most quickly in quartz sand and most slowly in humus, clay being, as usual, intermediate. Frost disappears most quickly when there is least moisture in the soil.[1]

[1] E. Wollny, Landw. Jahrb., 5, p. 441; Forsch. Geb. agr. Phys., 1, p. 43; Ibid., 2, p. 133; 3, p. 325; 4, pp. 147, 327, and 5, pp. 34, 167. Ebermayer, Ibid., 14, p. 195. A. Petit, Ibid., 16, p. 285.

INFLUENCE OF THE POSITION OF THE SOIL.

The temperature of the soil varies with a change in exposure. A southerly exposure is warmest; then easterly, westerly, and northerly exposures follow in the order named. In the course of the seasons the maximum temperature shows a fairly regularly recurring variation in a southerly exposure. In the winter months (November to April) the maximum is in the southwest, in summer (May to August) in the southeast, in autumn in the south, after which it returns toward the southwest. A southerly exposure is warmer and a northerly exposure colder the greater the inclination to the horizontal. The inclination of an easterly and a westerly exposure has comparatively less influence on the warmth of the soil, but the greater the inclination the warmer is the easterly and the colder is the westerly exposure. The difference in temperature between a northerly and a southerly exposure is considerably greater than between an easterly and a westerly. The difference in temperature between a northerly and a southerly exposure is wider the greater the inclination toward the horizontal. The angle of inclination has a much smaller influence on the differences in temperatures between an easterly and a westerly exposure. The west side is, when only slightly inclined (up to 15°), generally rather warmer than the east side, but when strongly inclined is colder.[1]

INFLUENCE OF THE COVERING OF THE SOIL.

A soil covered with living vegetation or with dead plants (leaves, straw, stable manure, wood, etc.) is warmer during the cold season and cooler during the warm season than an uncovered soil, other conditions being the same. This difference is greatest in summer and winter and least in spring and autumn. When warm periods occur in winter and cold ones in summer, the influence of the covering on the soil temperature is the reverse of that mentioned, at least in the uppermost layers. A bare soil warms up more quickly in spring and cools down more rapidly in autumn than one covered with vegetation or dead plants. Frost penetrates more slowly and to a less depth into the latter than into the former, but, on the other hand, a bare soil becomes free from frost earlier in the spring. The influence of the covering in the warm seasons is more marked as the exposure to the sun's rays is more complete, and *vice versa*. The characteristic action of vegetation is greater the denser and the further developed it is, and of other covers the thicker and more compact the layer. As regards the influence of different crops on the soil temperature, the development of the leafy parts, the

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[1] F. Kerner von Marilaun, Ztschr. österr. Ges. Meteorol., 6, p. 65; Sitzungsberichte der kaiserlichen Akademie der Wissenschaften in Wien, 1891, C Abtheilung 2a. C. Eser, Forsch. Geb. agr. Phys., 7, p. 100. E. Wollny, Ibid., 1, p. 263; 10, pp. 8, 345.

closeness of planting, and the length of the period of growth are of most importance.[1]

Soil coverings of mineral matter influence the temperature of the soil in different ways, according to their own thermal properties. Stones, gravel, sand, etc., when in a more or less thick and uniform layer over the soil, as a rule raise its temperature during the warmer seasons, but lower it during the cold season, when the exposure to the sun is slight. The influence of such a covering is generally more marked the darker the color and the more powerful the radiation. Soils having a high water capacity and a light color (clay, marl, chalk) have an effect the reverse of that of stone, gravel, sand, etc., when used as a covering, owing to the much greater loss of heat due to evaporation and the lower absorptive power for the sun's rays.[2]

Snow, as a bad conductor of heat, prevents rapid falls of temperature during the cold season, diminishes variations in temperature, and retards the penetration of frost. When the snow melts these conditions are usually reversed. The soil free from snow warms up more quickly, since it is generally dryer than that covered with snow. The latter also takes longer to become free from frost.[3]

INFLUENCE OF CLIMATE AND WEATHER ON THE TEMPERATURE OF THE SOIL.

The constitution of the soil being the same its temperature depends on the distribution of heat over the surface and also on certain local causes affecting the influence of the sun's radiation. The intensity of solar radiation varies with the altitude of the sun, and therefore decreases with the geographical latitude. For this reason the temperature of the soil decreases from the equator toward the poles, the decrease being more rapid as the 45th parallel is approached, after passing which it is slower. This decrease in soil temperature is, however, not uniform and proportional to the latitude, but exhibits many variations due to difference in length of exposure to the sun's rays, proportion of land and water, and local influences. The longer time of radiation in northern countries during summer causes a relative rise in temperature of the soil, without which the cultivation of the soil there would be impossible. On islands and near the coast the maximum

[1] E. Ebermayer, Die physikalischen Einwirkungen des Waldes, etc., 1873; Forsch. Geb. agr. Phys., 14, p. 379. E. Wollny, Der Einfluss der Pflanzendecke, etc., Berlin, 1877, p. 15; Forsch. Geb. agr. Phys., 6, p. 197; Ibid., 10, pp. 30, 345; 3, p. 143. A. Müttrich, Beobachtungen der Erdtemperatur an den forstlich-meteorologischen Stationen, 1880. Th. Nördlinger, Der Einfluss des Waldes auf die Luft und Bodenwärme, 1885. E. Ramann, Forstliche Bodenkunde, 1893, p. 96. A. Petit, Forsch. Geb. agr. Phys. 16, p. 285.

[2] E. Wollny, Der Einfluss der Pflanzendecke, etc., 1877, p. 36; Forsch. Geb. agr. Phys., 1, p. 44.

[3] E. Wollny, Der Einfluss der Pflanzendecke, etc., 1877, 11, p. 24. E. and H. Becquerel, Compt. Rend., 92, p. 1253. A. Wosikof, Der Einfluss einer Schneedecke auf Boden, Klima und Wetter. A. Penck, Geographische Abhandlungen, 3 (1889), No. 3. A. Petit, Forsch. Geb. agr. Phys., 16, p. 285.

and minimum soil temperatures are not so far apart as in regions remote from the coast. If we take into consideration also the action of numerous local influences (mechanical structure, exposure, inclination, covering of the soil, etc.), it is not surprising that the "isogeothermals" (*i. e.*, lines connecting places having the same average soil temperature) should diverge very considerably from the parallels of latitude.

The yearly, monthly, and seasonal temperature of the soil at the same latitude decreases as the altitude above the sea increases. This lowering of temperature with higher altitudes is greater in the soil than in the air, and is more noticeable in spring and summer than in autumn and winter. In spite of the greater exposure to the sun's rays in high altitudes during the summer the soil temperature is lower than on the plains, because the action of the sun's heat is shorter in duration and radiation of heat and consequent cooling during the night preponderates. Local influences (exposure and inclination, massiveness of the mountains, etc.) give rise under such circumstances to many modifications of the soil heat.

Regarding local influences, it should be noted that the condition of the atmosphere (precipitation and winds), the position and covering of the soil, the presence of bodies of water, etc., may cause numerous changes in the temperature of the soil.

The condition of the atmosphere is of importance inasmuch as the absorption of rays diminishes and the emission of rays increases as the air becomes rarefied and contains dust and water particles. Clouds and mist diminish the absorption and emission. Rain usually lowers the temperature of the soil, because the water is generally cooler than the soil, and also because the evaporation from the surface is increased by wetting. The opposite effect may be brought about in summer when the soil is covered with vegetation and is dried up by previous drought. In this case the precipitation may cause a rise in temperature owing to the improved conductivity for heat due to the moistening. Winds generally produce a lowering of temperature proportional to their velocity because they increase evaporation; and this effect is the stronger in proportion to the moistness of the soil and its capacity for replacing by capillarity the water lost by evaporation. Under some circumstances the temperature of the wind may be very important. Bodies of water may lower the temperature considerably during spring and summer without raising it in autumn and winter, and may therefore cause a moderate lowering of the average temperature of the land in the surrounding region. The influence of position and covering on the temperature of the soil has already been noted. The influence of vegetation, especially of forest growth, on the neighborhood is analogous to that of a body of water.[1]

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[1] C. S. Cornelius, Meteorologie, 1863, p. 113. J. R. Lorenz von Liburnau, Lehrbuch der Klimatologie, Wien, 1874, p. 230. J. Soyka, Der Boden, Leipzig, 1887, p. 135. E. Ebermayer, Die physikalischen Einwirkungen des Waldes, etc., 1873; Forsch. Geb. agr. Phys., 15, p. 385; J. A. Henselé, Ibid., 16, p. 357.

In conclusion, it must not be forgotten that variations in weather are accompanied by similar variations in soil temperature. It is not possible to formulate general laws on this subject, because the relationships are not only very complicated in their nature but are entirely local in character. In as far as it is possible to trace the connection between climate and soil temperature in a particular case, it has been done by K. Singer for the climate of the south Bavarian plain.[1] The results of this investigation may serve to show the conditions concerned and are therefore inserted below.

In the mild winter months, during which the precipitation is plentiful, there is no particular rise in temperature compared with the normal, but rather a fall in the soil temperature, especially in the deeper layers. Mild and dry winters have a tendency to cause the temperature to rise above the normal. The temperature of the soil during a winter of alternate frost and thaw, of which the average temperature is below the normal, shows a tendency to sink unless it is already very low. In the same way, when hard frost follows mild and wet weather in early winter even a covering of snow can prevent only to a slight extent the general lowering of the soil temperature. On the other hand, during a long and severe winter, in which the snow comes to stay in December, the variation of the soil temperature is either confined to the upper layers or does not occur at all.

A warm spring with, as is usual, a considerable amount of precipitation, causes a decided (relative) rise in the soil temperature. When a cold winter with much precipitation is followed immediately by a warm spring, the temperature of only the upper layer rises, while that of the lower layers may fall still further below the normal. In case of much precipitation the soil temperatures remain unchanged compared with the normal during the different spring months. A cold spring, which is generally accompanied by much snow, is associated, as a rule, with a decided lowering of the soil temperature, even to great depths compared with the normal. When the spring weather is cold and dry the relative lowering of the soil temperature is generally slight, if it has not been immediately preceded by periods of particularly large precipitation.

A warm summer is always accompanied by a high soil temperature or a rise. The rise is all the more noticeable when a large amount of precipitation accompanies the high temperature of the air or immediately precedes it. The rise in soil temperature is not much above the normal during the warm and dry summer months. The lowering of temperature always induced by a cool summer does not reach to great depths, scarcely to 4 meters. Those months in which this relative lowering of temperature could be detected down to 6 meters were all very wet.

A warm autumn causes, with few exceptions, a relative rise in the soil temperature. This rise is slight, and may even be changed to a fall

[1] Beobachtungen der meteorologischen Stationen im Königreich Bayern, 11.

when heavy precipitation occurs in late autumn. A low atmospheric temperature is accompanied, in the majority of cases, in autumn by an excess of atmospheric precipitation, and causes then a regular and often considerable fall in the soil temperature. In the less frequent cases of cool and dry autumn months there is, as a rule, only a very slight variation in the soil temperature.

THE DISTRIBUTION OF HEAT IN THE SOIL.

Daily variations.—During the cooler season, when the exposure to the sun's rays is slight, the temperature of the surface of the soil runs parallel to the minimum temperature of the air, but the maximum in the upper layers of the soil exceeds that of the air during the warmer season, and all the more the greater the exposure to the sun's rays and the greater the absorptive capacity of the soil.

The daily variations of temperature are greatest in the top layers, and decrease with the depth, generally disappearing at a depth of 1 meter. Considering the fact that the conduction of heat downward is gradual, it is clear that the extremes of temperature are later in the lower strata than at the surface and in proportion to the depth. The extent of this retardation depends on the physical properties of the soil, especially the conductivity for heat. In general the influences causing variations in temperature at the surface of the soil have less effect in proportion to the depth of the layer under consideration.

Yearly variations.—The yearly temperature variations are of considerable magnitude in the upper layers, decrease with the increasing depth, and finally disappear entirely. The depth at which a constant temperature obtains, or at least a temperature unaffected by the seasons, is dependent upon climatic conditions. In the tropics this depth is about 6 meters and in the temperate zones 20 to 30 meters. All factors which moderate the extremes of temperature, for instance, nearness to the sea, soil coverings of different kinds, etc., diminish also the variations in temperature. Observation teaches that in the temperate zone the variations in soil temperature cease at a depth of about 20 meters near the coast, but at about 30 meters at a distance from the sea. In the warm season the temperature of the soil diminishes on descending, but in the cold season increases with the depth.[1]

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[1] C. S. Cornelius, Meteorologie, 1863, p. 96. J. Soyka, Der Boden. Von Pettenkofer and Ziemssen, Handbuch der Hygiene, Theil 1, Abtheilung 2, Heft 3, 1887, p. 142. J. R. Lorenz von Liburnau, Lehrbuch der Klimatologie, 1871, p. 34. E. Ramann, Forstliche Bodenkunde, 1893, p. 95.

RECENT WORK IN AGRICULTURAL SCIENCE.

CHEMISTRY.

Paris green, composition and adulterations, B. B. ROSS (*Alabama College Sta. Bul. 58, pp. 7*).—The history and character of Paris green are discussed. According to Ehrmann pure Paris green contains 31.29 per cent of copper oxid, 58.65 per cent of arsenious acid, and 10.06 per cent of acetic acid. Analyses are given of 6 samples collected in the State and 1 from a chemical house in New York. Six of the samples showed arsenious acid ranging from 53.13 to 59.71 per cent, "and no traces of adulteration or attempts at adulteration were detected." A seventh sample, although resembling Paris green except in brightness of tint, contained no copper or arsenic. Prussian blue and chrome yellow were found, with a large quantity of inert matter, as clay, chalk, etc.

"On taking a small portion each of Prussian blue and chrome yellow and mixing with a large quantity of clay or chalk it was found that a product corresponding almost precisely in color to the material examined could be produced, and it was found quite easy to imitate the normal shade of color of Paris green, though the brightness of tint would be lacking. It was estimated that a material of this character could be manufactured at a cost not exceeding 1 ct. per pound, while a high grade Paris green frequently costs above 20 cts. per pound, the fraudulent manufacturer being thus able to dispose of his product at an enormous profit."

The method followed at the station for determining arsenious acid in Paris green is described.

On the determination of the bromin absorption of fats gravimetrically, O. HEHNER (*Analyst, 20 (1895), Mar., pp. 49–53*).—"The present contribution is merely intended as a study and not as a proposed method, although I believe that in some cases it may be found convenient and that it may afford another factor in judging of the constitution of an oil." The process is based on the fact that if bromin is added to an oil without the intervention of a solvent, combination takes place immediately, often with a rather violent reaction, but if diluted with a suitable solvent, as chloroform, the action is moderated but equally complete.

"I operate as follows in order to obtain the bromo compounds in a state fitted for weighing: A small, wide-mouthed fat flask is carefully weighed, and from 1 to 3 gm. of the fat to be tested introduced into it. These are dissolved in a few cc. of chloroform, and then pure bromin is added, drop by drop, until the bromin is decidedly in excess. Both the chloroform and bromin must be previously tested in a

blank experiment to make sure that they contain no appreciable residue. The flask is then heated on the water-bath till most of the bromin is driven off; a little more chloroform is added, and the mixture again heated, the chloroform vapor helping to drive out the excess of bromin. The addition of chloroform may once more be repeated. The flask and its content are then placed in an air bath regulated for about 125° C. and kept there until their weight is constant; this takes several hours. A little acrolein and hydrobromic acid escape during the drying, and the residue in some cases darkens slightly; in others a clear yellow heavy bromo oil is obtained. Drying at 100° C. does not lead to satisfactory results."

The results are given of a comparison on a number of common oils of the above process with the iodin absorption by Hübl, calculating the bromin absorption into the iodin equivalent by the factor 1.587. "In most cases the iodin figure calculated from the gravimetric bromin absorption is in satisfactory approximation to the Hübl number," but in the case of castor and linseed oils, which contain more oxygen than ordinary oils, "the figures are substantially different."

The determination of lecithin in seeds, E. SCHULZE (*Ztschr. Physiol. Chem., 20, Nos. 1 and 2, pp. 225–232; 3, p. 252*).—A reply to the criticism made by Von Bitto (E. S. R., 6, p. 270), that extraction as prescribed by Schulze (once with ether and twice with alcohol) does not dissolve all of the lecithin, but that to do this requires extraction 30 times with ethyl alcohol or 20 with methyl alcohol. Schulze insists that his method is sufficient provided the material is finely pulverized, and reports some experiments which appear to support his claim. He states further that 2 samples of methyl alcohol bought for the pure article could not be used for the extraction, since they dissolved from seeds other substances containing phosphorous besides lecithin, which were insoluble in ether, and at the boiling point dissolved small quantities of water-free sodium phosphate and potassium phosphate.

Coloring matter in California red wines, W. D. BIGELOW (*Jour. Amer. Chem. Soc., 17 (1895), No. 3, pp. 211–216*).—Ninety-four samples of California red wines were examined with the aid of the reagents commonly employed in the examination of European red wines. The reactions obtained were not always the same as those obtained with European wines; for instance, a gray, or yellowish or orange-gray precipitate or solution was sometimes obtained with reagents which are said to give green or grayish-green with French wines. On the other hand, no reactions were obtained which are said to be characteristic of wines colored with vegetable pigments.—W. D. BIGELOW.

Remarks on the spectrum of argon and of the aurora borealis, BERTHELOT (*Compt. Rend., 120 (1895), No. 12, pp. 662, 663*).

The forms of nitrogen in meat, E. SALKOWSKI and E. GIESKE (*Centbl. med. Wiss., 1894, pp. 833–835; abs. in Chem. Centbl., 1895, I, No. 3, p. 162*).

Investigation of the fat of oats, P. S. MOLJAWKO-WISTOZKI (*Diss. St. Petersburg, 1894; Pharm. Ztschr. Russland, 33, pp. 646, 647; abs. in Chem. Centbl., 1894, II, No. 33, p. 918*).

The transformation of starch into dextrin and maltose, DUCLAUX (*Ann. Inst. Pasteur, 9 (1895), No. 3, pp. 214–223*).—A critical review.

Some ester-like compounds of wood gum and xylose, R. BADER (*Chem. Ztg., 19 (1895), No. 4, pp. 55, 56; No. 5, pp. 78, 79*).

Chemistry of the albuminoids, L. LILIENFELD (*Du Bois-Reymond's Arch. Anat. und Physiol., 1894, pp. 555–558; abs. in Chem. Centbl., 1895, I, No. 4, p. 221*).

Asaprol, a reagent for albumen, albumose, pepton, and pepsin, RIEGLER (*Abs. in Chem. Ztg., 9 (1895), No. 28; Repert., p. 101*).

The coagulation of albuminoids by mechanical means, W. RAMSDEN (*Du Bois-Reymond's Arch. Anat. und Physiol., 1894, pp. 517–534; abs. in Chem. Centbl., 1895, I, No. 4, p. 221*).

Action of oxalic acid on inulin, G. DÜLL and C. J. LINTNER (*Chem. Ztg., 19 (1895), No. 9, p. 166; No. 11, pp. 216, 217*).

Action of diastase on reserve cellulose, J. GRUSS (*Abs. in Chem. Centbl., 1895, I, No. 15, p. 787*).

The solubility of sugar in mixtures of alcohol and water, O. SCHREFELD (*Ztschr. Ver. Rübenz. Ind., 1894, pp. 970–973; abs. in Chem. Centbl., 1895, I, No. 1, p. 69*).

The determination of casein in cow's milk, L. L. VAN SLYKE (*New York State Sta. Rpt. 1893, pp. 487–496*).—This paper was read before the Association of Official Agricultural Chemists in 1893, and published in full in the proceedings for that year (U. S. Dept. Agr., Div. of Chem. Bul. 38, pp. 109–116), and in *Jour. Amer. Chem. Soc., 15 (1893), No. 11, pp. 635–645.*

Rum analyses, P. H. GREG (*Bul. Bot. Dept. Jamaica, 2 (1895), No. 3, pp. 25–31*).

BOTANY.

Bacteria in agriculture, A. CARON (*Landw. Vers. Stat., 45 (1895), No. 5 and 6, pp. 401–418*).—The author briefly reviews some of the more recent literature relating to the assimilation of nitrogen by the micro-örganisms in the soil.

An estimation was made of the abundance of bacteria in various soils that had been cropped with oats, barley, and rye following wheat, rye, and wheat. There were found 1.5, 2.2, and 2.7 million bacteria per cubic centimeter in the three soils. It was also found that in black fallow, a fallow on which grass had been allowed to spring up prior to plowing under, the number of bacteria increases from spring until autumn, when their maximum number is to be found.

Investigations were conducted to ascertain the vertical distribution of soil bacteria, and it was found that they decrease with the increased depth of the soil from which they were taken, there being 6 million per cubic centimeter at a depth of 20 cm. and only 1.5 million at a depth of 50 cm. in a field examined.

Examinations were made of soil in which various crops, such as grain, clover, potatoes, etc., had been grown, and it was found that where grains were grown there was a decrease in the number of soil bacteria as the season advanced, while there was a constant increase in the case of the other crops. In this the author confirms the observations of Berthelot and Winogradsky[1] that grain crops do best when they follow such crops as legumes, potatoes, etc., or fallow, not only on account of the chemical and physical condition of the soil, but also on account of the presence of greater numbers of soil bacteria, by the aid of which greater amounts of nitrogen are supplied to the growing crop.

[1] Compt. Rend., 116 (1893), p. 1385.

The author isolated the bacteria from soils on which wheat and clover had been grown, and also from compost, making numerous pure cultures of them. Pot experiments were made to test their influence upon the growth of oats. The pots used were 22 cm. in diameter and each received 40 cc. of a bouillon culture, and all received the same fertilizers and treatment. At maturity the plants grown in the pots receiving the bacterial cultures gave as an average 18.46 gm. grain and 29.9 gm. straw, as compared with 13.26 and 22.14 gm. from the check pots.

Additional experiments were made to test the comparative value of the different kinds of bacteria isolated, the highest yield being secured when *Bacillus 39* was used for inoculating the soil.

In 1893 some field experiments were undertaken with oats in which the seed, prior to sowing, was impregnated with the desired organism by soaking for some time in liquid cultures containing it. The yields of grain from uninoculated seed and from seed so treated were in the proportion of 100:135. In the autumn the field where the oats had grown was plowed and in the spring sown with mustard. The yields of green forage on equal portions of uninoculated and inoculated plats may be represented by the proportion 100:195.

Numerous additional experiments were conducted which in every case gave a higher total yield whenever the soil or culture medium had received an inoculation with some form of soil bacteria.

The author made no attempt to show how the bacterial inoculations influenced the greater growth and productiveness of plants growing in inoculated soil, but he thinks it probable that the isolated bacteria used in the cultures possessed the same power of assimilating free nitrogen that is claimed for ordinary soil bacteria.

Upon some properties of soils which have grown a cereal crop and a leguminous crop for many years in succession, J. B. Lawes (*Agl. Students' Gaz., 7 (1895), No. 3, pp. 65–92, pl. 1*).—On a part of a field which had grown wheat for 39 years the crop was not cut in 1883, but all the grain was allowed to fall and thus reseed the land. No weeds were removed. In the second and third years there were only a few wheat plants, some of them having slender stalks and only one or two small seeds in the ear.

Four years after this field passed out of cultivation there were found growing in it 40 species of plants, and after 8 years more there were 51 species. Leguminous plants, especially *Lathyrus pratensis*, spread and grew luxuriantly.

In striking contrast with this was the paucity of species on an uncultivated field, which, when in cultivation, had been devoted to the continuous culture of beans; when the bean crop failed red clover and barley had been grown for a few years, the clover affording large yields. The vegetation on this field, when uncultivated, consisted of a few tall tufted-growing grasses; white clover growing in a pasture did not cross the border into this field which had borne leguminous crops for so long. For the cause of the luxuriance and variety of vegetation

on the plats long devoted to wheat culture and of the scant growth on the field which had long been devoted to leguminous plants the author does not present any explanation which he considers entirely adequate.

On land which for nearly 50 years had not been used for a leguminous crop, but had been devoted to a rotation of roots, cereals, and fallow, yellow trefoil made a strong effort to establish itself among the cultivated crops, and was exterminated with difficulty. "It is quite evident that when the land is kept free from leguminous plant growth matters accumulate in the soil which are highly favorable to these plants. . . . It is tolerably certain that the matter accumulated does not consist of ordinary manure ingredients."

On the distribution of assimilated iron compounds other than hæmoglobin and hæmatins in animal and vegetable cells, A. B. MACALLUM (*Proc. Roy. Soc., 57* (*1895*), *No. 343, pp. 261, 262*).—By means of freshly prepared ammonium hydrogen sulphid the author has demonstrated the presence of iron other than the above in plant and animal cells. Whether chlorophyll contains iron is yet to be demonstrated. Some of the more important facts ascertained by the author's investigations are as follows:

(1) Iron firmly combined is a constant constituent of animal and vegetable chromatin. Another compound, less rich in iron, is found in nucleoli.

(2) The chromophilous substance in ferment-forming cells contains iron, and the cytoplasm of protozoan organisms, which also probably secrete ferments, yields evidence of the presence of a firmly combined iron compound.

(3) A firm compound is present in the chromophilous substance of the cytoplasm of fungi.

(4) Of the non-nucleated organisms, bacteria, owing to their minuteness, have, with one exception, given little evidence of the presence of an organic iron compound; but in the *Cyanophyceæ* the chromophilous portions of the "central substance" contain iron, and iron may be demonstrated in the peripheral granules formed of the so-called cyanophycin.

Histological experiments on the development of mucors, M. LÉGER (*Compt. Rend., 120* (*1895*), *No. 11, pp. 647–649*).

The comparative anatomy of the fruit of conifers, M. RADAIS (*Ann. Sci. nat. Bot., 19* (*1894*), *ser. 7, No. 3–6, pp. 165–368, pls. 15*).

Concerning the plant cell membrane, C. CORRENS (*Pringsheim's Jahrb. wiss. Bot., 26, pp. 587–673; abs. in Bot. Ztg., 53* (*1895*), *II, No. 8, pp. 125–127*).

Plant forming elements, G. ABBEY (*Jour. Hort., 1895, n. s., Nos. 773, pp. 332, 333; 774, pp. 354–356*).—A semipopular article on plant nutrition.

The mineral food required by the lower fungi, I, H. MALISCH (*Sitzungsber. Wien. Akad. Wissensch., 1895*).

Concerning the waste products of plants, G. JAEGER (*Ber. deut. bot. Ges., 13* (*1895*), *No. 2, pp. 70–72*).

Contribution to the chemistry of chlorophyll, VI, E. SCHUNCK and L. MARCHLEWSKI (*Proc. Roy. Soc., 57* (*1895*), *No. 344, pp. 314–322, fig. 1*).

The production of blue and violet coloring matters in plants, C. NIENHAUS (*Schweiz. Wochenschr. Pharm., 33, pp. 3–11; abs. in Chem. Centbl., 1895, I, No. 9, p. 494*).

Concerning the structure and development of the spermatozoa of plants, W. BELLAJEFF (*Flora, 79 (1894); abs. in Bot. Centbl., 52 (1895), No. 2, pp. 50, 51*).

Coöperation of plants, G. CLAYTON (*Internat. Jour. Micr. and Nat. Sci., 5 (1895), No. 26, pp. 209–216*).—A popular discussion of symbiosis.

Root tublercles of leguminous plants, R. BEER (*Sci. Gos., 2 (1895), No. 15, pp. 70–72, figs. 4*).

Recent works concerning the tubercle bacteria of legumes and their fixation of free nitrogen, STUTZER (*Centbl. Bakt. und Par. Allg., 1 (1895), p. 68*).—A résumé.

A parasite valuable to the vine (*Gard. Chron., 17 (1895), p. 493*).—An abstract of a report by Zawodny on the discovery of a Mycorrhiza on grape roots.

Notes upon poisonous plants, B. D. HALSTED (*Garden and Forest, 8 (1895), p. 172*).—Popular notes are given on some of the more common poisonous plants growing in the region of New Brunswick, New Jersey.

List of the forage plants and weeds in the natural meadows of Modenese plain, L. MACCHIATI (*Staz. Sper. Agr. Ital., 28 (1895), No. 2, pp. 81–111*).

FERMENTATION—BACTERIOLOGY.

Concerning a new system of Bacteria, W. MIGULA (*Arb. bacter. Instit. Hochschule, Karlsrhue, 1895, No. 2; abs. in Hedwigia, 34 (1895), No. 2, Repert., pp. 44–46*).—The author proposes a new system of classifying bacteria as follows: I. Family COCCACEÆ, embracing (1) *Streptococcus*, (2) *Micrococcus*, (3) *Sarcina*, (4) *Planococcus* n. gen., (5) *Planosarcina* n. gen.; II. Family BACTERIACEÆ, (6) *Bacterium*, (7) *Bacillus*, (8) *Pseudomonas* n. gen.; III. Family SPIRILLACEÆ, (9) *Spirosoma* n. gen., (10) *Microspira*, (11) *Spirillum*, (12) *Spirochæte*; IV. Family CHLAMYDOBACTERIACEÆ, (13) *Streptothrix*, (14) *Cladothrix*, (15) *Crenothrix*, (16) *Phragmidiothrix*, (17) *Thiothrix*; and V. Family BEGGIATOACEÆ, (18) *Beggiatoa*. The last family provisionally inserted and may not properly belong here.

Thermophilic bacteria, A. MACFADDEN and F. R. BLOXALL (*Jour. Path. und Bact., 3 (1894), pp. 87–99; abs. in Jour. Chem. Soc. London, 1895, Feb., p. 58*).—An account of bacteria which flourish at high temperatures in manures, causing spontaneous combustion, etc.

A study of disinfectants for fecal matter, H. VINCENT (*Ann. Inst. Pasteur, 9 (1895), No. 1, pp. 1–39*).

Bactericidal action of light and air, R. F. D'ARCY and W. B. HARDY (*Jour. Physiol., 17 (1894), pp. 390–393; abs. in Jour. Chem. Soc. London, 68 (1895), Feb., p. 57*).

Effect of sunlight on tetanus cultures, F. F. WESBROOK (*Jour. Path. und Bact., 3 (1894), pp. 70–77; abs. in Jour. Chem. Soc. London, 68 (1895), Feb., p. 58*).

Studies on lactic fermentation, with bibliography, E. KAYSER (*Ann. Inst. Pasteur, 8 (1894), No. 11, pp. 737–784, dgms. 8*).

On the production of phosphorescence by Photobacterium sarcophilum, R. DUBOIS (*Rev. Mycol., 17 (1895), No. 2, pp. 59–64*).

Concerning Spirillum desulfuricans as a cause of sulphate reduction, M. W. BEYERINCK (*Centbl. Bakt. und Par. Allg., 1 (1895), pp. 1, 49, 104*).

The influence of copper sulphate on the fermentation of grape must by Saccharomyces ellipsoideus, F. KRUGER (*Centbl. Bakt. und Par. Allg., 1 (1895), pp. 10, 59*).

A physiological study of acetic acid fermentation and the artificial production of vinegar, F. LAFAR (*Centbl. Bakt. und Par. Allg., 1 (1895), p. 129*).

Microbes as factors in society, M. L. CAPITAN (*Pop. Sci. Monthly, 1895, Jan., pp. 103–109*).—Translation of an address delivered before the Anthropological Society of Paris, December 14, 1893.

METEOROLOGY.

New cloud classifications,[1] A. McAdie (*Phil. Soc. Washington, Bul., vol. 13, pp. 77–86*).—The history of cloud classification is briefly reviewed, and the system of Howard, proposed in 1802 and generally adopted until within a comparatively recent period, and that of Hildebrande, Abercromby, and Köppen, as modified and recommended by the International Meteorological Conference at Upsala in 1894, are explained and criticised, as well as those of Davis and Ley. The first is unsatisfactory in "that, being based purely on appearance, no account is taken of the origin and manner of formation of the cloud."

"Clouds of very dissimilar origin may have a similar appearance. Modern meteorology demands more than a record of the appearance of the cloud. It seeks the meaning of each formation and regards the cloud as an exponent of the physical processes operating in the air and resulting in cloudy condensation. The cloud is primarily valuable not on account of its beauty, but because it makes manifest motion in the atmosphere, which is not otherwise discernible. It outlines to some degree the storm mechanism at different levels in the atmosphere. Making due allowance for the fact that the cloud does not always give the true motion of the current in which it moves, as witness the Table cloud at Table Mountain, it is still, when rightly interpreted, a most significant index of air motion. There is no sound reason why the forecaster should not derive as much information concerning the movements of the air from a cloud map as from a pressure or temperature map. . . .

"[The second] classification takes some account of the cloud's altitude; and in differentiating clouds formed by diurnal ascending currents in calm air, generally of the summer cumulus type, from the clouds formed by widespread general uplifting of the vapor, some of the nimbus formations, this classification takes some account of cloud origin. In both of these directions the new system is preferable to the old; but the criticism can be fairly made that in the matter of cloud origin the new classification does not go far enough. . . .

"In addition to the direction and relative velocity of the cloud (the only conditions which have been thus far recognized or utilized in forecasting), it is demanded of the future cloud classification that it take into account the level in which the cloud is formed and the manner of formation. Some such scheme as the following might be profitably used:

Classification of clouds.

Altitude.	Formation.			
	Cooling by contact.	Mixture.	Ascension.	Electrical and critical.
Up to 250 meters	Fogs—haze, dust, and ground fogs.		Nimbus	
500 meters		Scud		
750 meters	Nocturnal radiation	Stratus	Summer cumuli	Hail clouds.
1,000 meters		Cumulo-stratus	Cumulo-nimbus	Cumulo-nimbus.
1,500 meters		Billows		
2,000 meters				
3,000 meters			Cumulus	
4,000 meters		Cirro-cumulus	Alto-cumulus	
5,000 meters		Cirro-stratus		
Above		Cirrus		

[1] Read before the Philosophical Society of Washington, March 2, 1895.

"The altitudes have been kept down purposely, because half of the whole amount of vapor in the air is below us at a height of 1,800 meters (less than 6,000 ft.), and it is but fair to assume that the clouds of most importance to us in forecasting are those formed below 2,000 meters. Above 8,000 meters there is practically no water vapor. Most of our clouds are formed under the second heading (mixture), where condensation results from the mixing of two imperfectly saturated currents. Where the mixing is not thorough, but confined to the edges, we have billow clouds; but while mixture is the most common cause of cloud formation, the cloud thus formed is not apt to give heavy rain. Clouds formed under the third heading (ascension), on the contrary, do give heavy rains. Here the cooling is by adiabatic expansion, and the ideal type of this formation is the cloud of the early afternoon in the tropics, with its torrential rain. Under the fourth heading (electrical) the cloud may keep adding to itself because of a very high surface electrification, or a cloud may be in such a critical condition that, as said above, the slightest jar suffices to produce great change. It is conceivable that a cloud-burst may be a sudden change of condition. . . .

"In order to get at the cloud's true meaning we must, in addition to equipping our observers with nephoscope and cloud atlas, have systematic measurements of the cloud height. This is now done at Blue Hill, Upsala, Storlein, and Berlin by means of theodolites and double observing stations. A more direct way, and one which we think is entirely practicable, is to send apparatus up into cloudland by means of kites. This would give us the conditions prevailing at different cloud levels, and the records would not be momentary."

The use of the spectroscope and electrometer in studying clouds is suggested. It is claimed that by means of a sensitive quadrant electrometer the author has been able to "tell of the approach of the cloud while yet far off and by the changes in the potential to roughly map out the sky."

Studies of the upper air,[1] A. L. ROTCH (*Boston Commonwealth, 1895, Apr. 6, pp. 8, pl. 1*).—The composition of the air brought down from the highest levels has been shown to be identical with that at the earth's surface. The pressure is reduced one half for each 3½ miles of ascent theoretically. The temperature toward the limit of the atmosphere must be far below any temperature ever observed at the earth's surface. The history of observations on the upper air by means of balloon ascensions (29,000 ft.), by balloons without aëronauts (over 10 miles), and from the summit of mountains (23,000 ft.) is reviewed.

Measures of the highest clouds (9 miles) have been made trigonometrically at Blue Hill, Massachusetts, and also in Sweden.

"A knowledge of the movement of high atmospheric layers is of great importance for the theory of the general circulation of the atmosphere, and practically for our weather forecasts, since the forces which develop storms have their origin and sphere of action within two or three miles of the earth." Continuous observations of all the elements in the higher atmosphere can only be made on mountains, though the conditions there can only approximate those in the free air. The discussions of observations at such high stations have contributed largely to the rapid progress of meteorology. The first summit station of any importance

[1] Read before the Boston Scientific Society, March 26, 1895.

was established in 1870 on Mount Washington, New Hampshire, (6,300 ft.). Here are experienced the severest weather conditions in the world. At present but two high-level stations are maintained in this country, at Mount Hamilton, California, and at Blue Hill, Massachusetts. The highest station in Europe is at Rochers des Bosses, 1,460 ft. below the summit of Mount Blanc.

The highest in Germany is on Sonnblick (10,170 ft.). The Eiffel tower in Paris has instruments at 980 ft. above the ground. Observations at such stations, however, can never take the place of records in the free air, and we must depend on records from balloons. The first scientific ascension was made from London by Jeffries in 1784. The instruments for making observations in balloons have recently been greatly improved. Berson last year made an ascension to nearly 29,000 ft. He found:

(1) A much more rapid decrease of temperature between 1 and 6 miles than has been assumed for winter.

(2) A rise of temperature in the morning and evening between the earth and 1 mile above it.

(3) A very feeble insolation, a great humidity of the upper strata, and a fine haze which extended to his highest point.

(4) A snowflake structure of the cirro-stratus clouds, formerly thought to be composed of ice crystals.

(5) A great increase of wind, from nearly a calm at the earth to 36 miles per hour at the average height of the balloon.

Kites have been used for determining meteorologic conditions in the atmosphere, and their use has been begun very recently at Blue Hill, Massachusetts.—H. A. HAZEN.

The high flight of the balloon "Cirrus," A. BERSON (*Ztschr. Luftschifffahrt, 1895, Feb. and Mar., p. 73*).—The author gives an account of a second high flight of the "Cirrus," September 6, 1894, and of the ascensions at the same time of the balloons "Phœnix" (70,600 cu. ft. capacity) and "Majestic" (106,000 cu. ft.). The balloon "Cirrus" reached 61,000 ft. (11.74 miles), and brought back a temperature record of $-89°$ F. ($-67°$ C.) at the highest point. Its velocity was 83 miles per hour toward the ENE. It was not found till the last of September, near Wilna, in Russia. The "Phœnix" reached a little over 20,000 ft. and moved at about 38 miles per hour at an average height of 15,000 ft. The lowest temperature was $-15°$ F. ($-26°$ C.). The diminution in temperature for the "Cirrus" was 2.4° F. in each 1,000 ft. of height (44° C. in 100 meters), and that of the "Phœnix" was 4° F. in 1,000 ft. (.73° C. in 100 meters). This is an extraordinary difference and is due in large part, if not wholly, to the increased heat experienced at the very highest point from insolation, although it is highly probable that the temperature does diminish at a slightly less rate in Europe at the higher elevations. The "Majestic" failed to reach any high altitude.

Such experiments, though giving us meager information of the higher regions, are of the greatest value. If it be true that our cold and hot

waves extend up to the limits of our atmosphere and are of cosmical origin, then it is of the greatest importance that conditions in them at high levels be observed.—H. A. HAZEN.

Droughts and famines in India, J. ELIOT (*U. S. Dept. Agr., Weather Bureau Bul. 11, pt. 2, Rpt. Internat. Meteorolog. Congress, 1893, pt. 2, pp. 444–459, pls. 2*).—This is a most interesting and exhaustive treatment of all the facts known regarding these terrible visitations. During 122 years there have been 17 famines. Statistics of the 8 intense famines are given, with loss of life and property, or expenditure of money to give relief.

The areas most liable to drought are chiefly in the tropical belt, where the rains are periodic. Prolonged droughts are more frequent in India than anywhere else in the world. The meteorologic features of the Indian monsoon area may be divided into two periods—the northeast monsoon of dry land winds, from January to May, and the southwest monsoon of humid sea winds, from June to December. The southwest monsoon air circulation is caused, at first, by the formation of a low pressure area over northern India in April and May because of a rapid rise in temperature. It is a breaking down of the southeast trades at the equator and an adaptation of their circulation to the changed conditions at the north. The maintenance of the new order is due to a self-contained energy liberated by rainfall rather than to a continuance of the hot weather conditions in the north. The greater part of the rainfall of India (37 in., or 90 per cent.) occurs during this southwest monsoon. Just before this wind begins northern India is one of the hottest and driest areas in the world. Occasionally maximum shade temperatures of 120° and 124° are registered. The relative humidity often falls below 20 per cent, and 1 per cent has been recorded. The variation of rainfall is greater than in any other country. In Sinde the average is 5 in. per year, and in the Khasia Hills there are 500 in., which is the greatest in the world. The range from year to year is very great; at Kurrachi, 0.47 in. in 1872, and 28 in. in 1869; at Jacobabad in 36 years, least 0.72, greatest 12.05 in.

There are three zones of rainfall in India: (1) The arid zone, with less than 15 in. rain in a year. Here cultivation is dependent on irrigation and there are practically no famines. (2) The dry zone, with 15 to 35 in. of rain. Rain sufficient in average years, but prolonged drought leads to great scarcity. (3) The moist zone, with rain 35 to 500 in. It is a singular fact that the rain is most variable where it is smallest in amount and most regular where it is greatest; hence this zone has no famines.

Favorable conditions for crops are as follows: (1) For cold weather crops (wheat, barley, pulse, etc.) a moderate rain in October, to fit the ground for plowing and in order that the moisture may germinate the seed. Occasional light showers, more especially on the higher lands, in order to develop the grain. (2) For hot weather crops of rice, heavy burst of rain for planting, moderate rain during growth, and a burst

of rain to fully insure the growth of the ear. (3) For hot weather crops of millets, etc., rather heavy rain at first and occasional rains afterwards are best suited. Breaks of three or four weeks, especially if accompanied by dry, hot winds, are very injurious, and if protracted, fatal.

In north India famine is due either to the failure of two crops in succession, for example, the rain crops (millets and rice), and the cold weather crop, or to the complete failure of one crop after a series of poor seasons.

In the Deccan they are usually due to a more or less complete failure of a southwest monsoon rain throughout, following one or more bad seasons.

In the rice-growing districts the cause is usually an abnormally early end of the southwest monsoon rains.—H. A. HAZEN.

Meteorologic work in Australia, C. TODD (*Adelaide: pp. 25, pl. 1*).—This important paper describes in detail methods and results of meteorological inquiry in Australia. There are given in 7 charts types of weather selected from a larger number, and it is stated that these charts have been sufficiently studied to show what resulting weather is likely to follow, as determined from previous experience. These charts are distributed to all the stations. After the telegrams have all been received on any day and the new chart constructed, the proper type weather map can easily be found which corresponds with this new chart. The only expense then consists in telegraphing to each station the number of the chart which should be displayed for that type.

There is a ridge of high pressure which passes over the extra-tropical or temperate parts of Australia. This is made up of long loops or "highs," being broken up at times by the advance of "lows" from the tropics and northerly extensions of V-shaped low areas from the south. The position of this ridge in winter is 29 or 30° south latitude. North of this ridge are the dry southeast trades, while to the south there is a prevalence of dry northerly winds, varied by strong west and southwest winds as coastal lows pass from west to east, with rain and squalls. On the east coast winter winds are from the west. This wall or ridge plays a very important part in Australian climate. If this lies well to the south then south Australia is dry, while to the north there are frequent rains. If the wall is in the north these conditions are reversed. About 43 high areas pass during the year, with a velocity of about 17 miles per hour. The movement of low areas is much more marked and regular, there being about 60 per year, with a velocity of 25 miles per hour.

Since the interior of Australia is under high pressure, with dry southeast winds, it is often subject to severe droughts, more or less prolonged. The driest portion is in a belt of country from Lake Eyre, or about latitude 30°, to near the northwest coast, which is swept nearly all the year by the southeast trade wind. The climate of the eastern half is more favorable, owing to the more southerly sweep of the monsoon

rains. The following is the experience in the past: In 13 years, with the summer pressure above and temperature below normal, the following winter rain was below the average 9 years, above it but once, and exactly average three times. In 9 years, with summer pressure and temperature the opposite of the above conditions, the winter rain was above the average seven times; below only once, and just average once. In other words, "Summer cool, with high pressure; winter dry. Summer hot, with low pressure; winter wet."

The question of seasonal or long range weather forecasts has been seriously considered. The importance of reliable forecasts to the farmer is undoubted, but they must be reasonably accurate and based on positive knowledge or they will be treated with contempt. Long range forecasts are possible only after "the accumulation and intelligent discussion of the necessary data and the correlation of weather conditions over considerable areas of the earth's surface."

"India is the only country which has attempted anything like a systematic issue of seasonal forecasts. These are mainly based on the amount of snow falling during the previous winter on the Himalayas, and the general character of the weather in India during the five or six months preceding the setting in of the southwest monsoon; the chief objects of the forecasts being to give some idea of the probable rainfall during the ensuing monsoon."

A more uniform publication of observations to enable a better study of the records, and also a fuller discussion of these records year by year is urged. There is also great need of normal isobaric and isothermic charts for each month and the year.—H. A. HAZEN.

The climate of Cordova, Argentine Republic (*An. Ofic. Meteorol. Argentina, vol. IX, Buenos Ayres, pt. I, 1893, pp. 678; II, 1894, pp. 491, pls. 25*).—Of all the South American States, the Argentine Republic is the most progressive in the organization of a climatological system. The above-named publication of nearly 1,200 large quarto pages in 2 parts is devoted, with the exception of a few pages of annual report, entirely to statistics and discussions relating to the climate of one locality. Part I contains the records made at Córdova from 1872 to 1892, expressed in daily, decade, monthly, and annual means. From January, 1889, to the close of 1892 the hourly values are recorded. Part II contains the discussion of observations recorded in part I and a record of observations for 1893. Some of the most general results relating to temperature of the air, rainfall, and evaporation for the period from 1873 to 1893 are as follows: *Temperature* (degrees C.)—maximum 41.8, minimum 8.9, average 16.7; *rainfall* (mm.)—maximum monthly 116.5, minimum monthly 4.1, total 703.1; *evaporation* (mm.)—exposed evaporimeter 64.8, protected evaporimeter 31.4.—O. L. FASSIG.

Magnetical and meteorological observations made at the Government Observatory, Bombay, in the year 1893 (*Bombay: 15 (1894), No. 15, pp. 12*).—This volume is the thirty-second of the series, extending the record from 1845 up to 1893. Magnetical and meteorological observations are taken daily at 6 and 10 a. m. and at 2, 6, and

10 p. m., at which time the general atmospheric conditions are noted. Automatic records by magnetographs, barograph, thermograph, pluviograph, and anemograph are made.

The mean annual temperature for 1893 was 78.9° F.; greatest mean daily temperature, 86° (April 16); least mean daily temperature, 68.1° (February 8); maximum temperature, 92.1° (April); minimum temperature, 59.8° (February). Total rainfall, 64.63 in.; number of cloudy days, 118, and greatest daily fall of rain, 4.98 in. (June 20).—O. L. FASSIG.

Origin of cold waves, H. A. HAZEN (*Monthly Review Iowa Weather and Crop Service, 6 (1895), No. 3, pp. 4, 5*).—Data in support of the theory that cold waves originate in the upper region of the air.

On the first mercury thermometer, MAZE (*Compt. Rend., 120 (1895), No. 13, pp. 732, 733*).—The invention of the mercury thermometer is attributed not to Fahrenheit, but to Bouilliau, who in the latter part of March, 1859, made comparative observations on an alcohol thermometer and on a mercury thermometer.

On an old French series of thermometric and meteorological observations, MAZE (*Compt. Rend., 120 (1895), No. 13, pp. 731, 732*).

Meteorological record for January and February, 1895 (*Massachusetts State Sta. Bul. 57, p. 1*).—Notes on the weather and a brief summary of observations on temperature, precipitation, and wind movement.

Meteorological observations at Massachusetts Hatch Station, C. D. WARNER and F. L. WARREN (*Massachusetts Hatch Sta. Met. Buls. 73–75, pp. 4 each*).—Daily and monthly summaries of observations during January, February, and March, 1895, with general remarks on the weather of each month.

Monthly Weather Review of the Nebraska Weather Service, 1894 (*Nebraska Sta. Bul. 37, pp. 96, figs. 52*).—Summaries for each month of 1894 of meteorological observations by the State Weather Service coöperating with the Weather Bureau of this Department, accompanied by outline maps of the State showing isotherms, direction of the wind, and precipitation, and charts recording velocity of wind, temperature, pressure, humidity, and precipitation, as shown by self-registering instruments at the station.

Meteorology for 1893, R. D. NEWTON (*New York State Sta. Rpt. 1893, pp. 718–733*).—This includes tables showing precipitation by months since 1882; wind record for 1893; sunshine records for 1893; a summary of sunshine records, May 1, 1885, to January 1, 1894, and daily readings of maximum, minimum, and standard air thermometers.

North Carolina weather during January and February, 1895, H. B. BATTLE, C. F. VON HERRMANN, and R. NUNN (*North Carolina Sta. Weather Service Bul. 64, pp. 1–16, maps 2; 65, pp. 19–32, maps 2*).—The usual records of observations.

WATER—SOILS.

Contributions to the study of the reclaimed marshes of the region of Médoc, France, F. BERTHAULT and J. CROCHETELLE (*Ann. Agron., 21 (1895), No. 3, pp. 122–134*).—This is an account of an investigation, including observations on crops and system of culture and physical and chemical analyses of soils of the reclaimed lands along the left bank of the Gironde estuary in the region of Médoc. These lands are protected on the west from the violent and salt sea winds by sand dunes which have been covered by forest growth and other vegetation, while the waters of the estuary are kept out by dikes and

the soil is drained by numerous ditches and canals. Occasionally, however, the salt water breaks through the dikes, flooding the land and making it unfit for cultivation for several years.

In a study of the causes of the sterility thus produced the authors found that when soils which had thus been flooded contained 0.5 per cent of salt the growth of the ordinary field crops was seriously retarded, but that with 0.2 per cent cereals grew normally. It was further observed, however, that in soils of this region, termed saline and abandoned for that reason, sterility was sometimes due to a deficiency of phosphoric acid and to slow nitrification resulting from imperfect cultivation.

On the composition of drainage waters, P. P. DEHÉRAIN (*Compt. Rend., 120* (*1895*), *No. 13, pp. 701–706*).—An account is given of observations in the same line as those reviewed in previous numbers of the Record.[1] Comparing the results obtained in 1893, which was a year of poor crops, with those obtained in 1894, a season of good crops, it was found that drainage water was more abundant and much richer in 1893 than in 1894. The poverty of the waters in 1894 is attributed to the vigor of the plants, which by means of their numerous roots completely assimilated the nitrates. The diminished amount of drainage was due to the vigorous leaf growth, which returned to the atmosphere all of the water supplied by precipitation except during wet periods. Abundant drainage was obtained only during the winter, while during the summer no water passed off in the drains.

It is calculated that the wheat crop of 1894 per hectare contained 91 kg. of nitrogen and in 1893 only 44.2 kg., but in 1893 the soil lost 49.7 kg. of nitric nitrogen in the drainage water, while in 1894 the loss from this source was insignificant. The total amount of nitrogen removed from the soil in the good season of 1894 was therefore 91 kg., as against 93.9 kg. in the bad season of 1893.

Further experiments by the author confirm previous conclusions that fallow soils lose much more nitrogen in the drainage than those covered with crops, and emphasize the importance of planting autumn catch crops.

The more important results obtained on 20 vegetation boxes left bare and bearing various crops (grapes, sugar beets, wheat, and oats) are given in the following table:

Losses of nitric nitrogen in drainage waters.

	Loss per hectare.	Ratio of drainage to rainfall.
Bare soil:	*Kg.*	
1893–'94	101.60	4.5
1894–'95	79.80	5.5
Soil bearing crops:		
1893	33.25	7.6
1894	.20	135.0

[1] E. S. R., 6, pp. 353, 491.

Attention is especially called to the facts that the losses from covered soil were much greater in 1893 than in 1894, and that both the losses and the ratios of drainage to rainfall were higher than those reported by Schlössing (see below).

The loss of nitrogen in drainage water, T. SCHLÖSSING (*Compt. Rend., 120 (1895), No. 10, pp. 526–530*).—The author maintains that the studies on this subject, made for the most part in vegetation pots or boxes, for obvious reasons, have given results much in excess of the truth, and that examinations of the water of streams draining a given area will furnish a more accurate measure of the loss of nitrogen in drainage. Determinations of nitric nitrogen in the waters of the Seine, Marne, Yonne, and Oise are reported, and estimates based on the results are given which indicate that each hectare of soil in the Seine basin loses 4.2 kg. of nitric nitrogen if one sixth of the rainfall escapes in the drainage, 6.44 kg. if one fourth escapes, and 8.48 kg. if one third escapes. It is stated that while these results do not warrant definite conclusions they nevertheless indicate that the losses of nitrogen in the drainage water are not so important as has been supposed.

A chemical process of purifying water, F. BORDAS and C. GIRARD (*Compt. Rend., 120 (1895), No. 12, pp. 689–691*).—In this process slightly more permanganate of lime than is necessary to oxidize the organic matter is added to the water and the excess of permanganate reduced and the color destroyed by manganese dioxid.

Soil temperatures (*Nebraska Sta. Bul. 37, pp. 96, charts 12*).—Charts are given showing soil temperatures at the station at depths of from 1 to 36 in. during each month of 1894.

Soil temperatures, R. D. NEWTON (*New York State Sta. Rpt. 1893, pp. 734–739*).—Tridaily readings of soil thermometers at depths of 1 to 18 in. are recorded for 6 months (May to October) of 1893.

FERTILIZERS.

The influence of oxid of iron and alumina in the reversion of superphosphate, A. SMETHAM (*Jour. Soc. Chem. Ind., 14 (1895), No. 2, pp. 112–114; 3, pp. 242, 243*).—The chemical changes which take place in the reversion of the monophosphate of lime in superphosphates to dibasic phosphate are explained, and it is claimed that "where fine grinding is the rule, and where the mixing is complete, and the acid usually in excess of that required for the transforming of the tribasic phosphate to monobasic form, reversion due to the formation of a dibasic phosphate is seldom, if ever, met with." When, however, as is usually the case, the original phosphate contains an appreciable amount of oxid of iron or alumina it is found that the solubility of the phosphoric acid of the superphosphate diminishes to a considerable extent on keeping, any quantity over a very small percentage of oxid of iron and alumina being considered "as reverting double its weight of soluble phosphate."

In studying the relative effects of oxid of iron and alumina in causing reversion the author selected samples of known history and char-

acter and determined (1) the effect on the solubility of the phosphoric acid of adding known quantities of the oxid of iron or alumina, and (2) the solubility of the latter at different periods.

In a superphosphate containing 25.97 per cent of soluble phosphoric acid and 3.21 per cent of insoluble phosphoric acid the addition of an amount of sulphate of iron containing Fe_2O_3 equal to 1.36 per cent of the superphosphate resulted in the immediate reversion of 1.86 per cent of acid, 2.39 per cent in one year, and 2.42 per cent in 15 months. Aluminum sulphate was added to the same superphosphate in an amount furnishing Al_2O_3 equal to 1.1 per cent of the whole mixture, but the results were much less marked than in the case of the addition of iron. The immediate reversion was 0.17 per cent, at the end of a year 0.83 per cent, and at the end of 15 months 1.02 per cent. An examination of other samples of superphosphate showed that reversion was due principally to the oxid of iron present.

A superphosphate which showed when made 36.5 per cent of soluble phosphoric acid contained at the end of a year 38.19 per cent, and it is noted that in case of high percentage superphosphates there is frequently an increase rather than a decrease of soluble phosphoric acid on keeping.

"A review of the facts already obtained makes it pretty certain that there is a wide difference in the behavior of oxid of iron and alumina in the manufacture of superphosphate. The first, for practical purposes, seems to revert phosphate in what may be called theoretical proportions, viz, 160:310, or as nearly as possible 2 parts of phosphate to 1 of oxid of iron, while the alumina, which, if acting in the same manner as oxid of iron, would revert three times its weight of phosphate, at most seems to cause a retrogression of its own weight. It has long been known that superphosphate manufactured from Florida phosphate increases in the percentage of soluble phosphate instead of retrograding, and as this phosphate contains scarcely any oxid of iron, but 2 to 3 per cent of alumina, it was difficult to understand this behavior. The foregoing results, however, explain the matter.

"Under these circumstances, and especially as many of the phosphates now coming into the market contain alumina in larger proportions than oxid of iron, it appears to me that there is pressing need for a revision of the terms of the contracts on which phosphates are usually sold, and for a differentiation of oxid of iron and alumina in the analysis upon which the sales are made."

In the discussion following the reading of this paper its essential conclusions were confirmed by several other analysts.

Farmyard manure (*Agl. Jour. Cape Colony, 8 (1895), No. 5, p. 111*).—In trials of covered and uncovered manure on potatoes and wheat during 2 years the results strongly favored the covered manure.

Utilization of the refuse bones of the farm, L. GRANDEAU (*Jour. Agr. Prat., 59 (1895), No. 15, pp. 527, 528*).

Nitrate deposits in South Africa (*L'Engrais, 10 (1895), No. 15, p. 352*).—The discovery of nitrate deposits in caves near Prieska at an elevation of 3,000 to 4,000 ft. is noted. The material is composed generally of nitrate of lime, but sometimes contains 95 per cent of finely crystallized nitrate of potash. The nitrates are believed to be formed from the accumulated excrement of rabbits, which breed in numbers in that locality. An English company has been organized for the exploitation of the deposits.

What is Thomas slag and how shall it be used? M. MÄRCKER (*Ztschr. landw. Ver. Hessen, 1895, No. 12, pp. 90–92; Wochenschr. pom. ökon. Ges., 25 (1895), No. 7, pp. 79–81; Königsberger land- und forstw. Ztg., 1895, No. 11*).

Note on the decomposition of phosphates containing fluorin, S. FEITLER (*Dingler's polytech. Jour., 294, pp. 188, 189; abs. in Jour. Soc. Chem. Ind., 14 (1895), No. 3, p. 286*).

Commercial fertilizers (*Kentucky Sta. Bul. 52, pp. 83–116*).—Analyses and valuations of 11 official samples of fertilizers (sent to the station by manufacturers) and 87 samples sent by farmers or taken by deputy inspectors are tabulated and discussed.

Inspection and analyses of commercial fertilizers sold in Maryland, H. B. MCDONNELL, ET AL. (*Maryland Sta. Bul. 30, pp. 3–54*).—Explanations of terms used in fertilizer analyses, notes on guaranties and valuation, a list of manufacturers licensed to sell fertilizers in Maryland in 1894, text of the State fertilizer law, and tabulated analyses and valuations of 362 samples of fertilizing materials.

Analyses and valuation of manurial substances (*Massachusetts State Sta. Bul. 57, pp. 6–8*).—A schedule of trade values for 1895 is given, together with tabulated analyses of 22 samples of fertilizing materials, including ashes, cotton-hull ashes, ground bone, cotton-seed meal, guano, sheep fertilizer, and peat.

Commercial fertilizers, P. COLLIER and L. L. VAN SLYKE (*New York State Sta. Rpt. 1893, pp. 181–204, 497–539*).—Text of the State fertilizer law, notes on the agreement of actual and guaranteed composition, valuation, and home-mixing, and tabulated analyses of 330 samples of fertilizers, with a statement of the amounts of different kinds of fertilizers reported as sold in the State during the year ending November 1, 1893. The aggregate amount was 106,520 tons.

Fertilizer analyses, H. B. BATTLE (*North Carolina Sta. Spec. Bul. 24, pp. 14; 25, pp. 16*).—These bulletins give a digest of the State fertilizer laws, explanations of terms used in analysis, notes on valuation, freight rates, and tabulated analyses and valuations of 313 samples of fertilizers.

Analyses of commercial fertilizers, J. L. HILLS and B. O. WHITE (*Vermont Sta. Bul. 45, pp. 3–8*).—A schedule of trade values for 1895, notes on valuation, tabulated analyses of 15 samples of fertilizers, and a list of manufacturers paying license fees as required by law.

FIELD CROPS.

Field experiments with corn, 1894, F. D. GARDNER (*Illinois Sta. Bul. 37, pp. 24*).

Synopsis.—Accounts are given of experiments in the following lines: (1) Test of varieties, (2) time of planting, (3) thickness of planting, (4) continuous cropping *vs.* a rotation of crops, (5) cross fertilization, (6) detasseling, and (7) listing. The results of these and previous experiments at the station favor (1) the medium maturing white varieties, (2) planting in May, especially from the 11th to the 18th of the month, (3) thick planting, (4) rotation of crops, and (5) cross fertilization. The yield of detasseled corn in 1894 was 13 per cent greater than that not detasseled, although in 1891 and 1892 detasseling had exercised no marked effect on the yield.

The experiments in 1894 were in continuation of those reported in Bulletin 31 of the station (E. S. R., 6, p. 29). They were conducted on dark colored, fertile prairie soil in hills 3 ft. 8 in. apart each way.

Varieties (pp. 1–16).—The test of varieties occupied 84 fortieth-acre plats, and the results are given in detail in tables, summaries, and general notes. Mixtures of 2 and 4 varieties gave larger yields in 1894 than single varieties, though mixtures did not afford the larger yield every

year. The height of stalks and size of ears increased with lateness of maturity. Of 13 varieties tested during 5 years Boone County White gave the largest yield, 71.5 bu. per acre, followed by Burr White, 61.9 bu., and Leaming, 60.7 bu. per acre. The medium maturing varieties averaged for 7 years 65.2 bu., the late varieties 58.8 bu., and the early varieties 55.5 bu.; the yellow varieties averaged for 7 years 60.3 bu. per acre, and the white varieties 63.2 bu.

Time of planting (pp. 16–18).—Burr White was planted at intervals of a week from April 6 to June 22; the average yield for 7 years was greater from planting from May 11 to May 18. The variation was slight for the dates between April 27 and May 25.

Thickness of planting (pp. 18, 19).—In 1894, 2, 3, 4, and 5 kernels were planted in hills 3 ft. 8 in. apart each way; the yield from planting 2 kernels was 40.2, 3 kernels 46, 4 kernels 49, and 5 kernels 48 bu. per acre. In another field with 3 kernels per hill the yield was 44.6, and with 4 kernels 50.5 bu. per acre.

Continuous corn cropping compared with rotation of crops (pp. 19, 20).—Corn grown in rotation with oats and clover yielded 40 per cent more than corn in continuous culture. Tabulated data give the yields in detail.

Cross fertilization (pp. 19, 20).—From cross fertilized plants seed was selected in 1892 and again in 1893, the latter, together with both parent varieties, being used for the crop of 1894. The average increase in yield in 1894 from the cross fertilized seed was 12 bu. per acre.

Detasseling (pp. 21–23).—The tassels were removed from stalks on alternate rows; on the detasseled rows the yield was 56.5 bu., and on those not detasseled 50 bu. per acre. The increase in yield was greater where the tassels were removed early than where they were removed later. Contradictory results secured in previous years and at other stations are briefly noted. "If an increase in grain is secured by detasseling, it is most likely to be on poor soil or in dry seasons. It seems that the injury done the plants sometimes reduces the yield."

Corn, W. W. Cooke and F. L. Watrous (*Colorado Sta. Bul. 30, pp. 12–21, 24, 25*).—Eight varieties of flint corn and 14 of dent corn were tested. The average yield of dry matter per acre was with the small flint varieties 2.70 tons, with the large flint varieties 2.51 tons, with the small dent varieties 3.60 tons, and with the large dent varieties 3.38 tons. The largest yield of corn, 43 bu. per acre, was made by the small dent varieties Huron and White Pearl. The earliest variety was a small flint, Will 70-Day Gehu, which yielded 37.8 bu. of corn per acre, and which seems adapted to many portions of the State which are generally regarded as too cold for corn.

Red Cob corn cut September 29 afforded no more dry matter per acre than when cut September 5. "The figures seem to show that in this part of Colorado, so near the foothills, corn can not be depended on to grow after the first week in September, and such varieties should be chosen as will reach the glazing stage by that time."

Coöperative soil tests with corn, A. J. BONDURANT (*Alabama College Sta. Bul. 59, pp. 23*).—This is a report of coöperative tests in 23 localities. A fertilizer consisting of equal parts of cotton-seed meal and superphosphate, applied to corn at the rate of 1,000 lbs. per acre, resulted in a financial loss of $2.29 per acre. The author assumes that peas planted between the corn rows would have yielded in the same proportion as the corn, and on this basis calculates a profit of 71 cts. per acre in favor of fertilizers.

The loss of corn fodder in drying, W. W. COOKE and F. L. WATROUS (*Colorado Sta. Bul. 30, pp. 23, 24*).—In 1893 the loss of dry matter in field curing corn was fully one third. In 1894 corn was cured in shocks, each containing about 500 lbs. of green fodder, in small shocks, and in a thin layer on the ground.

"So far as could be told by the eye there had been no loss. The fodder had cured in nice shape, and the stalks on the inside of the bundles retained their green color, with no sign of molding or heating. And yet the large shocks had lost 31 per cent of their dry matter, or feeding value, the small shocks 43 per cent, and the corn spread on the ground 55 per cent.

"On breaking or cutting the stalks these losses were explained. The juice was acid, and there was a very strong acid odor, showing that an active fermentation was taking place in this seemingly dry fodder."

Flax for seed and fiber, C. R. DODGE (*U. S. Dept. Agr., Farmers' Bul. 27, pp. 16*).—The author shows that good seed and salable fiber can be produced from the same plant. He points out the need of scutch mills, and advises a threefold division of labor in establishing an American flax fiber industry, viz, the growing of the crop by the farmer, the retting and scutching by the purchaser or factor, and the spinning and weaving by the manufacturer.

Other topics treated are soil selection and preparation, fertilizing, rotation, kind and amount of seed, meteorological considerations, and harvesting seed and fiber.

Experiments with foreign seeds, P. H. MELL (*Alabama College Sta. Bul. 60, pp. 27–32*).—Analyses are given of *Eleusine corocana* and *Paspalum scorbiculatum*, two foreign plants which proved satisfactory for forage. Japanese buckwheat, flat pea, and soja beans succeeded on the station farm. Sugar beets, damaged by nematodes, contained 8.5 to 11.4 per cent of sugar. Chick-pea, sesame, and green gram (*Phaseolus mungo*) were grown, and the last-named plant matured earlier than the garden pea.

A contribution to the study of hops, A. LEPLAE (*Contribution a l'étude du houblon. Bruxelles: 1895, pp. 84, figs. 72*).—This publication is chiefly devoted to the methods of drying hops and to the construction of hop kilns. Chemical and mechanical analyses of dried hops, qualities desired in hops, and methods of harvesting also receive attention.

Although the cones bearing seeds do not contain less lupulin than the unfertilized flowers, they are not favorably regarded by brewers in

Belgium. However, the entire destruction of the male plants so as to prevent fructification not only diminishes the yield, but delays the development of the cones.

The author favors curing by means of flue heat rather than with open fires, because the former conserves the natural aroma, reduces the danger from fire, and permits the easy regulation of temperature and draft. He states that the initial temperature of drying should not exceed 95° F., and that the temperature should never rise above 104° F. A temperature too high causes the loss of essential oil, imparts a distinct and undesirable odor, and injures the appearance of the product.

He regards sulphuring as indispensable, as it destroys fungi and thus permits the easier conservation of hops, without, as he states, endangering the health of consumers of beer. Kaemmerer had shown that hops took up about 0.48 per cent of their weight of sulphurous acid, of which, however, only one fourth or one fifth was retained permanently, the remainder being dissipated in about 4 weeks.

The author regards 1 to 1½ lbs. of sulphur as sufficient for 100 lbs. of hops, if the sulphur is burned early in the process of drying.

Oats, A. C. MAGRUDER (*Oklahoma Sta. Bul. 16, pp. 33–40*).—With the Jensen hot-water treatment for smut the yield was increased 1.41 bu. per acre. When the seed bed was rolled twice the yield was slightly reduced. Broadcasting afforded a smaller yield than did the press drill. Subsoiling reduced the yield on alkali land. Fifty varieties, of which the seed was grown in Oklahoma or farther south, averaged 13.8 bu. per acre; 34 varieties from the States farther north 12.4 bu. The variety Lincoln is recommended. Deep fall plowing gave a larger yield than deep spring plowing or shallow fall plowing. Other subjects briefly mentioned are amount of mixture between varieties, quantity of seed, and continuous culture of oats without manure.

Varieties of potatoes, F. W. RANE (*West Virginia Sta. Bul. 38, pp. 32–38, 46–50, figs. 3*).—Of 36 varieties tested on single or duplicate rows 75 ft. long, the following are recommended: American Wonder, Rural New Yorker No. 2, Great Divide, Superior, Crown Jewel, Early Everitt, and Maggie Murphy.

Potato experiments, R. H. MILLER and E. H. BRINKLEY (*Maryland Sta. Bul. 31, pp. 73–82*).—The experiments consisted of tests of varieties, green manuring, spraying, distance, methods of cultivation, and amount of seed. When crimson clover was plowed under as a green manure early in May the yield increased by more than 19 bu. per acre. Spraying with Bordeaux mixture afforded a larger yield than the untreated plat, and when spraying was begun early the yield was further increased. Distances of 14½ by 30 in. afforded a larger yield than distances of 12 by 36 in. Deep cultivation, ridge culture, and cultivation continued late in the season proved slightly advantageous. Small whole seed potatoes afforded a larger profit than large whole potatoes and cuttings.

Determination of sugar in beets, cornstalks, and sorghum, P. COLLIER (*New York State Sta. Rpt. 1893, pp. 176–178*).—The percentages of sugar in 8 varieties of beets, in the stalks of 3 varieties of sweet corn, and in sorghum are given. The juice of the cornstalks averaged 11.4 per cent of total sugar, "or nearly 92 per cent of that present in the sugar cane juice." The weight of topped and stripped stalks of sweet corn growing on an acre is estimated at 9,257 lbs., but the quantity of juice is not reported.

The composition of wheat grown on saline soil, BERTHAULT and CROCHETELLE (*Compt. Rend., 120* (*1895*), *No. 12, pp. 691–693*).—In Algeria it frequently occurs that hot weather early in June causes vigorous wheat plants on certain kinds of soil to lose their green color, the heads drying and the grain becoming shriveled and hard. The crop is largely reduced. This trouble occurs on saline soil. A sample of such soil contained 0.64 per cent of potash, 0.26 per cent of soda, and 0.014 per cent of chlorin. The nodes and the middle internodes of wheat plants affected as above were covered with a deposit of chlorid of potash. Chlorid of potash was found to be most abundant in the nodes, the dry matter of which contained 0.718 per cent of this salt, while the dry matter of the entire plant contained 0.125 per cent.

Farm notes for 1894, W. W. COOKE and F. L. WATROUS (*Colorado Sta. Bul. 30, pp. 3–12*).—Six varieties of wheat, 15 of oats, 8 of barley, 4 of buckwheat, 6 of millet, and 5 of beets were tested. Polish wheat, also incorrectly known as Mammoth Spring rye, yielded under unfavorable conditions 25 bu. of grain per acre. It is recommended as a stock food, but needs first to be ground. Of the varieties of barley tested the California is recommended, on account of its productiveness and drought-resisting qualities. The effects of tankage and bone meal were tested on potatoes, with inconclusive results.

Yellow millo maize, white millo maize, evergreen broom corn, Japan broom corn, African millet, Jerusalem corn, Egyptian corn, red Kaffir corn, and white Kaffir corn were grown; yellow millo maize ripened earliest and afforded the largest yield of forage and of grain.

Flat pea (*Lathyrus sylvestris*) and sachaline (*Polygonum sachalinense*) showed no very desirable qualities. Rape yielded very heavily, the smallest yield on any plat being 22 tons of forage per acre.

Alfalfa, its characteristics, cultivation, worth, uses, and adaptability to Kansas (*Rpt. Kansas Bd. Agr. 1895, Mar. 31, pp. 3–43*).—This is an abridgment of a previous report on alfalfa culture in the West.

Jerusalem artichoke (*Agl. Jour. Cape Colony, 8* (*1895*), *No. 5, pp. 109, 110*).—Notes on the culture, yield, and value.

Sprouting beet seed before sowing (*Landw. Centbl. Posen, 33* (*1895*), *No. 13, p. 74*).

Cañaigre, A. E. BLOUNT (*New Mexico Sta. Bul. 14, pp. 37–44*).—This is a general discussion of the subject, the topics treated being description of the plant, habits of growth, yield, relative value as a tannin plant, and methods of cultivation. On irrigated land on the station farm the yield was estimated at 4 to 10 tons of green cañaigre per acre. Cañaigre seed germinated satisfactorily.

Canary seed (*Abs. in Agl. Jour. Cape Colony, 8 (1895), No. 5, pp. 108, 109*).—The article gives directions for the cultivation and harvesting of *Phalaris canariensis* grown for the seed.

Analyses of varieties of corn, V. VEDRÖDI (*Chem. Ztg., 19 (1895), No. 17, p. 350*).—Analyses of American and Hungarian varieties of corn.

American cotton in Turkestan, C. JONAS (*U. S. Consular Rpt. 1895, Jan., pp. 123–125*).

Flax cultivation in Ireland, J. B. TANEY (*U. S. Consular Rpt. 1895, Jan., pp. 51–57*).—This report is largely statistical.

Fertilizer experiments on flax in 1894 (*Mitt. deut. landw. Ges., 1895, No. 3, pp. 21, 22*).

What is common millet? A. A. CROZIER (*Agl. Sci., 8 (1894), No. 10–11, pp. 449, 450*).

Experiments with varieties of potatoes, J. DUFOUR and F. PÉNEVEYRE (*Chron. Agr. Cant. Vaud, 8 (1895), No. 7, pp. 163–168*).

Mulching potatoes, F. A. WAUGH (*Oklahoma Sta. Bul. 15, p. 32*).—Mulching soon after the plants came up largely increased the total yield and afforded larger potatoes and a higher percentage of merchantable potatoes.

Mangel-wurzels, carrots, turnips, ruta-bagas, and sugar beets, C. F. CURTISS (*Iowa Sta. Bul. 27, pp. 114–119*).—As a root crop for most classes of stock the flat turnip is preferred; but carrots are best suited for horses. General notes on varieties and culture of roots and analyses of sugar beets grown in 1894 are given.

Turnips, cabbage, sweet corn, and potatoes, J. WILSON (*Iowa Sta. Bul. 27, pp. 105–108*).—This article consists of notes on these crops during the dry season of 1893. A yield of turnips at the rate of 24 tons per acre was attributed by the author to the frequent and careful cultivation of the surface soil.

Nebraska and the beet-sugar industry, M. HOLLRUNG (*Nebraska Sta. Bul. 38, pp. 97–126*).—This publication is a translation by H. H. Nicholson of a report made on the above subject and published in the *Zeitschrift des Vereins für die Rübenzucker Industrie des Deutschen Reichs*. Special attention is devoted to the conditions of soil, climate, and labor in Nebraska, and the comparative expense of growing an acre of sugar beets in Nebraska and Germany.

Fertilizer experiments on tobacco, BARTH (*Mitt. deut landw. Ges., 1895, No. 2, pp. 13–15*).—The effect of potash on burning quality of tobacco is especially noted.

American tobacco for Italy (*U. S. Consular Rpt. 1895, Mar., pp. 422–425*).

Greek tobacco, its composition and statistics of culture, A. K. DAMBERGIS (*Internat. Kong. angew. Chem. Brüssel; abs. in Chem. Centbl., 1895, I, No. 9, p. 491*).

Subsoiling, S. KELSEY (*Rpt. Kansas Bd. Agr. 1895, Mar. 31, pp. 203–206*).—A record of a favorable experience in Kansas.

The press drill vs. the common grain drill, C. F. CURTISS (*Iowa Sta. Bul. 27, pp. 113, 114*).—Winter wheat sown in October with the press drill yielded more than the same variety planted with the common grain drill. The variety of winter wheat recommended is the Turkish Red.

HORTICULTURE.

Influence of climate on onions from seed, J. TROOP (*Indiana Sta. Bul. 53, pp. 118, 119, figs. 2*).—Experiments with 3 plats of onions grown from native and foreign seeds to determine their comparative value. The land used was the surface of an old marsh cleared and cropped a year previous. There were sown seeds of the Prizetaker variety, grown in Italy, and also seed grown in Minnesota. French-grown seed of Giant Rocca was sown as a test to show that any difference in yields in the 2 plats of Prizetaker was not due to soil differences.

The seed was sown in 14 in. drills, April 7, and on September 7 the Italian onions were ripe, while the plants from the Minnesota seed were still green and showing very few bulbs. Later in the season some of the Minnesota onions formed small, soft bulbs of little market value. The estimated yield per acre was as follows: Italian Prizetaker 500 bu., Minnesota Prizetaker 33 bu., French Giant Rocca 518 bu. Some of the Minnesota seed was sown also in that State, where it produced a large crop of fine onions.

The experiment is considered as indicating that failure in onion crops is as frequently due to improper climatic conditions as to poor seed.

Sweet potatoes, culture and uses, J. F. DUGGAR (*U. S. Dept. Agr., Farmers' Bul. 26, pp. 30, figs. 4*).—A popular bulletin containing information upon the propagation, soil, transplanting, cultivation, manuring, harvesting and storing, varieties, fungus diseases, insect enemies, uses, and cost of production of sweet potatoes. Propagation by means of sets is advised, although in some cases larger yields have been produced from cuttings. The preferred method of constructing a plant bed is detailed, the potatoes being placed on a thin layer of sand over a thick basis of fresh, moistened barnyard manure, and covered with wood earth. An illustration is given of an artificially heated propagating bed. Sound, well-formed potatoes of small to medium size are recommended, from 2 to 4 bu. furnishing sufficient sets to plant an acre, about 3 "drawings" being made.

A light, well-drained soil is advised, the sets being transplanted on low ridges by hand or mechanical devices when danger from frost is over and the sprouts are from 3 to 5 in. above the ground. Placing the plants 18 in. to 2 ft. apart in 3½ to 4 ft. rows seems to give the best results. Shallow, clean cultivation, discontinued the latter part of the season, is recommended, and moving the vines after the last cultivation is not considered necessary.

Analyses of sweet potato roots and vines, showing the fertilizing ingredients removed by them from the soil, are given, as also formulas for fertilizers to replace the loss. A fair yield per acre is stated to be 185 bu. (10,000 lbs.), extracting from the ground 23 lbs. of nitrogen, 10 lbs. of phosphoric acid, and 50 lbs. of potash, which can be restored to the soil by 150 lbs. of nitrate of soda, 90 lbs. of acid phosphate, and 370 lbs. of kainit.

It is advised that sweet potatoes be kept at a temperature of 75° F. for a week or two after digging, and throughout the winter the temperature be maintained at 50 to 60° F. The storage room or cellar should be dry, to avoid the induction of decay by moisture condensing on the roots.

As varieties for consumption in the Southern States are recommended Sugar Yam, Yellow Yam, and Barbadoes; in the Northern States, Big Stem Jersey and Nansemond; as food for live stock, Providence, Shanghai, Hayman, Red Bermuda, and Southern Queen, these being the most productive.

The diseases treated of are the black rot (*Ceratocystis fimbriata*), soil rot (*Acrocystis batatas*), soft rot (*Rhizopus nigricans*), dry rot (*Phoma batatæ*), white rot, sweet-potato scurf (*Manilochætes infuscans*), stem rot, leaf blight (*Phyllosticta bataticola*), and white leaf scab (*Albugo ipomϾ-panduranæ*). Destroying infected roots and giving a rotation of crops is advised in general, and for the soft rot dusting the stored potatoes with fostite. Brief mention is made of cutworms, flea beetles, tortoise beetles, sweet-potato sawflies, the sweet-potato root beetle (*Cylas formicarius*), and sweet-potato hawk moth. Spraying with Paris green is recommended for all but the root beetle, for which pulling up and burning all affected roots and vines is given as the only remedy.

Drying and canning sweet potatoes are discussed, as also the value of the crop as a food for stock, for which purpose its more extensive use is urged. The average composition of several varieties of sweet potatoes is tabulated, and the relative food value of sweet potatoes and corn compared, by which it is seen that 3 lbs. of sweet potatoes contain nearly as much dry matter and quite as much carbonaceous material as 1 lb. of corn, but less than half as much protein. The cost of growing and harvesting an acre of sweet potatoes, exclusive of rent and fertilizers, is estimated to average about $20.

A summary is appended, embodying the main points of the bulletin.

Sweet potatoes, H. N. STARNES (*Georgia Sta. Bul. 25, pp. 127–161*).—In the abstract of this bulletin in a recent number of the Record (6, No. 9, p. 811) an error occurs in the first line of the quoted passage at the top of page 812 which reverses the author's conclusions. The sentence should read "The split-leaf varieties are among the most unproductive." In the preceding sentence of the abstract the word "Clay," used as a synonym for the variety Shanghai, should be "California."

Notes on tomatoes, M. J. HUFFINGTON (*Colorado Sta. Bul. 30, pp. 26–32*).—Descriptive notes and tabulated data on a comparative test of 39 varieties grown at the station in 1894. The plants were started in a forcing house and handled once before planting in the open ground. They were irrigated 4 times during the growing season. As a rule the newer varieties did not prove equal to the older standard kinds. Maule Earliest of All, Vaughan Earliest of All, Atlantic Prize, Perfection, Rosebud, and Ignotum produced the largest yields. For canning are recommended Beauty, Perfection, Long Keeper, Puritan, Ignotum, and Royal Red.

Report of the horticulturist, S. A. BEACH (*New York State Sta. Rpt. 1893, pp. 543–685, pls. 4, fig. 1*).—This report begins with brief remarks on the horticultural work accomplished by the station during the year in testing varieties, originating new fruits, giving addresses before farmers' clubs and institutes throughout the State, and displaying exhibits at the World's Fair at Chicago and at the State and local fairs.

Vegetables grown for exhibition (pp. 545–598).—A reprint of Bulletin 69 of the station (E. S. R., 6, p. 53).

Variety tests of apples (pp. 599–616).—Descriptive notes on 13 varieties of apples, chiefly of Russian origin, with a table showing the yield of 83 varieties of apples and 14 of crab apples. In addition are given lists of 126 varieties of pears, 7 of quinces, 143 of plums, 86 of peaches, 38 of cherries, 37 of currants, and 212 of gooseberries growing at the station.

Variety tests of grapes (pp. 617–626).—Comparative notes on 42 varieties, the species from which each is believed to have been derived being designated. A list of 210 varieties growing in the station vineyard is appended.

Variety tests of blackberries, dewberries, and raspberries (pp. 626–655).—A reprint of Bulletin 63 of the station (E. S. R., 5, p. 786).

Some experiences in testing strawberries (pp. 656–676).—A reprint from Bulletin 64 of the station (E. S. R., 5, p. 874), with in addition a list of 128 varieties fruiting at the station in 1893, and descriptive and comparative notes on 34 of them.

Strawberry crosses (pp. 677–685).—A reprint from Bulletin 64 of the station (E. S. R., 5, p. 874).

Garden vegetables, F. A. WAUGH (*Oklahoma Sta. Bul. 15, pp. 17–29, figs. 7*).—Comparative notes and tabulated data on 15 varieties of peas, 26 of muskmelons, 25 of watermelons, 34 of cucumbers, 30 of lettuce, 11 of potatoes, 14 of tomatoes, 10 of onions, 4 of okra and salsify. The following varieties are recommended: *Muskmelons*—Early Nutmeg, Jenny Lind, and Banquet; *lettuce*—Denver Market, Hanson, and Henderson New York; *tomatoes*—Dwarf Champion, Dwarf Aristocrat, Perfection, Matchless, Optimus, and Ignotum; *onions*—Prizetaker; *okra*—White Velvet and Dwarf.

The recent apple failures of western New York, L. H. BAILEY (*New York Cornell Sta. Bul. 84, pp. 34, pls. 4, figs. 6*).

Synopsis.—A discussion of the causes of the small apple crops in late years, with letters from a number of prominent orchardists in regard to experience with spraying trees. For the production of large crops is advised liberal tilling, efficient fertilizing, careful pruning, and judicious spraying.

It is stated that one of the most important reasons for the failure of the apple crop is the usual custom of allowing the orchards to run to sod or else growing cereals among the trees. In this way the soil is impoverished and the fruit trees can make but a scanty growth. It is urged that orchards be well drained and frequently and lightly cultivated during the late spring and early summer, followed by the sparing use of nitrogenous fertilizers. The tillage will serve as a conservator of moisture, and in this way prevent great damage by drought. In orchards which have been long in sod the turf should be broken up in the spring while soft by means of a sharp-toothed harrow, and afterwards plowed shallow. As fertilizers, potash and phosphoric acid are

recommended, supplemented by nitrogen furnished by green manure crops, especially crimson clover.

The apple scab fungus, however, is believed to be the most prominent factor in crop failures, and its life history and damage are treated of at length and illustrated by a colored plate. Against the scab spraying with Bordeaux mixture is strongly advised, and results of experiments are given showing the benefit to be derived from this method. From 2 to 4 applications of the fungicide, beginning when the blossoms fall, and preferably applied during rainy weather, when the fungus spreads most seriously, are recommended.

It is believed that injurious insects can generally be held in check by means of spraying with Paris green, which can be advantageously combined with Bordeaux mixture. Letters are published from 5 prominent apple growers in the State who have experimented with spraying their trees with Bordeaux mixture, and who unite in urging the importance of early and thorough spraying. The illustrations are of imperfect or diseased fruit and branches and sprayed and unsprayed orchards.

Russian apples in Indiana, J. Troop (*Indiana Sta. Bul. 53, pp. 123–125*).—Descriptive and comparative notes on 16 Russian varieties fruiting in the station orchard in 1894. The apples are considered as best suited for cooking purposes, although some of them make fair dessert fruit. The trees were hardy, thrifty, and healthy. None of the varieties have so far proved to be winter apples, all of them ripening in the summer and fall. It is believed that in colder climates, such as the northern parts of the United States, the varieties will do even better.

Grapes, F. A. Waugh (*Oklahoma Sta. Bul. 14, pp. 14, pl. 1, figs. 6*).—This bulletin contains remarks on the location and exposure of the station vineyard, with an account of the methods of planting, pruning, and training employed. The Munson system of pruning and training is adopted, and is liked on account of the height at which the vines are trained, thus avoiding injury to the ripening grapes by reflected heat from the ground. The horizontal training of the shoots also offers less surface to the wind. The vineyard has not been troubled by injurious insects or diseases, with the exception of a temporary attack by the spotted grape beetle (*Pelidnota punctata*), that yielded promptly to spraying with arsenate of lead. Some of the bunches were bagged, which proceeding it is thought improved their appearance and kept them in better condition after ripening.

About 200 species and varieties are grown in the vineyard, of which 85 were in bearing last year. Brief descriptive and comparative notes are given for 33 black, 22 white, and 16 red varieties, showing also the weight and yield per vine. The following varieties are recommended for planting: *Black*—Janesville, Hartford Prolific, Champion, and Early Victor for early varieties; Herbert, Worden, Wilder, Concord,

and Barry for general crop; *white*—Faith, F. B. Hayes, and Moore Diamond; *red*—Perkins, Brilliant, Goethe, and Catawba; *wine grapes*—Herbemont, Herman Jaeger, Cunningham, Elvira, Jaquez, and Catawba.

Some obstacles to successful fruit growing, F. W. CARD (*Nebraska Sta. Bul. 39, pp. 127–139, pl. 1*).

Synopsis.—The chief obstacles in the way of orchards in Nebraska are stated to be borers, mice and rabbits, crown galls, nematode galls, and drought. The results of experiments made to obviate these evils are given and remedies suggested.

The flat-headed borer (*Chrysobothris femorata*) is believed to do more damage than any other of the several species attacking fruit trees in the State, being far more injurious than the round-headed borer causing damage in the East. The life history is briefly noted. Experiments were made by applying various substances to the trunks of trees in early summer to prevent the beetles from laying their eggs. They were as follows: Soapsuds containing a little kerosene; carbolic acid and potash wash; potash, lard, and lime wash; white-lead paint; and copperas and lime whitewash. The best result was obtained by means of the white lead paint, although the washes containing potash are also recommended. The mixtures may be applied by means of an old broom, and one application will last 3 or 4 months.

In the case of damage by gnawing by mice and rabbits a thin coating of grafting wax over the injured portion was found to be more satisfactory than the mixture of soil and cow manure usually applied. Keeping the orchards clean from weeds and rubbish is recommended and rubbing the trunks of the trees with bloody meat or other disagreeable substances in the fall.

Crown galls, producing a rough, knotty growth on the trunks at the surface of the ground, are discussed and illustrated from photographs, but no remedy except that of destroying affected trees is suggested. Nematode root galls, which are sometimes found on trees received from the Southern States, it is believed will not cause much trouble in Nebraska on account of the cold winters killing the worms.

The greatest loss to fruit growers is believed to be due to lack of rain, and the question of preventing damage from drought by means of furnishing sufficient moisture to the soil is discussed. It is believed that frequent shallow cultivation will cause a greater conservation of moisture in the soil than can be supplied by irrigation. The opinions of prominent orchardists in the State are quite in support of this view. The planting of wind-breaks by the side of orchards is urged to prevent evaporation by winds. To test the value of different methods of cultivation the station orchard was divided up into plats, one of which was pastured, another mowed, a third harrowed every 2 weeks until the first part of August, while on the fourth shallow cultivation was continued until the beginning of October. The foliage made a much more thrifty growth in the cultivated plats, and the yield of fruit was 17 per

cent greater than that from the mowed portion and 14 per cent greater than from that pastured. The moisture content of the soil for the first 20 in. was 20.4 per cent in that part of the orchard cultivated the entire season, against only 14 per cent in the mowed portion. As a result of the experiments frequent shallow cultivation to provide a mulch layer of loose, mellow soil is urged.

Protecting fruit from birds, J. TROOP (*Indiana Sta. Bul. 53, pp. 125, 126, pl. 1*).—In order to protect cherries from destruction by birds during the period of ripening, several trees of Russian varieties were covered with bird netting when the fruit began to ripen. The experiment was found to be successful, completely protecting the fruit, while other trees left open and uncovered were entirely stripped of their fruit. Two 6-year-old trees of Bessarabian cherries bore one half bushel each of fine fruit, while an unprotected tree of the same variety and age lost every cherry upon it. The advisability of thus protecting ripening cherries is believed to be thoroughly established. The expense of netting is small, 4 cts. per square yard, and soon balanced by the increased crops obtained. About 75 sq. yd. of netting were used on trees 10 ft. high.

Relation of blossoms to fruit, J. L. BUDD (*Trans. Iowa Hort. Soc. 1893, pp. 444–447*).—This paper states that flowers possessing slight staminate development produce better fruit than those more perfect. Recently top-worked apple trees produce earlier and hardier blossoms than do other trees, owing to the fact that the constriction at the point of union between graft and stock assists in the greater storage of starch in the twigs, thus furnishing more nutrition. Ringing trees also increases the productiveness and quality of the fruit, and enables the blossoms to withstand a lower temperature, for a similar reason. Drift soils on lower levels were found not to nourish the blossoming branches sufficiently to produce as satisfactory crops as were grown on higher bluff and loess soils. Manuring and irrigating unfruitful trees was found to induce a fair crop of fruit. Culture during the early summer and shading the soil during the hot months by a growth of buckwheat or a mulch of straw or coarse manure improved the general condition of the trees and increased the crops. Varieties produced by crossing native apples on Russian varieties were found to have the hardiness of the Russian parent, as well as quality of fruit approaching that of the native parent.

Best ferns for the North and Northwest, G. W. CARVER (*Iowa Sta. Bul. 27, pp. 150–153*).—This comprises some notes on various ornamental ferns for decorative purposes, several species of maidenhair ferns (*Adiantum* spp.), *Pteris*, *Onychium japonicum*, words ferns (*Nephrolepis*), *Cheilanthes tomentosa*, and *Selaginella* being recommended. Directions are given for propagating and growing ferns, the principal methods of propagation being given as dividing large plants, growing from buds, and growing from spores. Planting the ferns in a mixture of leaf

mold, sand, and peat is advised, the pots being frequently watered and liquid manure occasionally applied, a repotting with fresh earth being given from time to time.

What is a cantaloupe? F. A. WAUGH (*Garden and Forest, 8 (1895), No. 376, pp. 183, 184*).—A discussion of the vagueness of the name, which in the South is applied to small, globular, netted, green-fleshed muskmelons, and in the North to larger, ovoid, smoother, yellow-fleshed fruit. The writer believes that the term should be limited to hard, rough-skinned, deeply grooved melons.

Some results obtained in crossing cucurbits, L. H. PAMMEL (*Trans. Iowa Hort. Soc. 1893, pp. 320–322*).—Brief notes on experiments in crossing plants of this kind, different species being found not to hybridize. No immediate results were found to follow crossing.

About mushrooms, the study of esculent and poisonous species, J. A. PALMER, Jr. (*Boston: Lee & Shepard, pp. 100*).

Top grafting the apple, C. G. PATTON (*Trans. Iowa Hort. Soc. 1893, pp. 203–210*).—A report on the answers to a circular letter on the subject sent out to numerous fruit growers in Iowa and adjoining States in regard to the influence of stock and scion. It is stated that the seedlings of a species make the best stocks for the different varieties of that species. The Transcendent crab is recommended for some varieties, especially Russian. It is advised that top grafting be done low when the stock is from 3 to 7 years old.

Dried apples in Germany, W. H. ROBERTSON (*U. S. Consular Rpt. 1895, Jan., pp. 89–92*).—A brief mention of official measures being taken in Germany to prevent the sale of American dried apples on the ground of their containing zinc. The writer urges that American producers of dried apples use wooden trays for drying, thus avoiding any objections on the point of zinc adulteration. It is believed, however, that the unwholesomeness of the fruit has been exaggerated.

New seedling plums, H. A. TERRY (*Trans. Iowa Hort. Soc. 1893, pp. 275, 276*).—Descriptive notes on 19 varieties, chiefly originating in Iowa.

Stone fruits in 1893, J. L. BUDD (*Trans. Iowa Hort. Soc. 1893, pp. 136–141*).—Some notes on experiments in propagating plums and cherries, with remarks on some other stone fruits. The sand cherry is recommended as a promising stock.

Top grafting, N. E. HANSEN (*Trans. Iowa Hort. Soc. 1893, pp. 362–364, fig. 1*).—Some popular directions on the subject.

New varieties of small fruit, R. D. MCGEEHON (*Trans. Iowa Hort. Soc. 1893, pp. 43–45*).—Brief descriptive notes on 11 recent varieties of strawberries, 5 of raspberries, and 1 of blackberries.

Strawberry culture, R. D. MCGEEHON (*Trans. Iowa Hort. Soc. 1893, pp. 456–459*).—Notes on successful methods, the details of cultivation being given.

Small fruits, C. ROOT (*Trans. Iowa Hort. Soc. 1893, pp. 68–72*).—A brief article on the cultivation, manuring, varieties, winter protection, and spraying of small fruits, particularly strawberries.

The Munson grape trellis, F. A. WAUGH (*Garden and Forest, 8 (1895), p. 186*).

Fruit culture, W. A. LUCE (*Maine Bd. Agr. Rpt. 1893–'94, pp. 188–191*).—A general popular paper on the culture of small fruits, strawberries being mentioned in particular.

Varieties and localities, C. L. WATROUS (*Trans. Iowa Hort. Soc. 1893, pp. 311–316*).—A popular discussion of the variation in the same variety when grown in different climates and latitudes.

The blossoms of the orchard fruits, N. E. HANSEN (*Trans. Iowa Hort. Soc. 1893, pp. 154–157*).—Notes on investigations to determine the reasons for the nonfertility of fruit blossoms. Plums, pears, and apples were experimented with, and numerous varieties were found to be self-sterile owing to peculiar development of the sexual elements.

Definite annual growth and its relations to hardiness, L. H. PAMMEL (*Trans. Iowa Hort. Soc. 1893, pp. 104–113, pl. 1*).—A discussion of the subject from the standpoint of morphological botany, with notes on a number of varieties of apple trees.

The improvement of our native fruits, B. A. MATTHEWS (*Trans. Iowa Hort. Soc. 1893, pp. 102, 103*).—Brief notes on some improved Iowa wild fruits, chiefly plums, crab apples, mulberries, juneberries, and gooseberries.

The relation of soil and climate to Iowa horticulture, D. A. KENT (*Trans. Iowa Hort. Soc. 1893, pp. 73–76*).—A popular paper giving an analysis of a sample of Iowa black loam and stating that the fertility of the prairie is due to the fact that the soluble elements in the soil are protected by freezing during the period of the greatest precipitation, when they might otherwise be dissolved and carried off by the rains.

Horticulture from a climatic standpoint, J. R. SAGE (*Trans. Iowa Hort. Soc. 1893, pp. 143–147*).—The author urges the careful study of the yearly temperature in determining the varieties to be grown, and the importance of furnishing the proper supply of moisture.

Horticultural lessons from the Columbian Exposition (*Trans. Iowa Hort. Soc. 1893, pp. 96–102*).—General article on the subject, with special reference to the Iowa fruit display.

The farmer's fruit and vegetable garden, W. S. FULTZ (*Trans. Iowa Hort. Soc. 1893, pp. 177–180*).—A general paper giving popular instructions and recommendations.

Fruit farming in Luxemburg, G. H. MURPHY (*U. S. Consular Rpt. 1895, Jan., pp. 75–80*).

The commercial preservation of fruits, J. L. BUDD (*Trans. Iowa Hort. Soc. 1893, pp. 270–272*).—A discussion of the methods of preserving fruit by means of cold storage, drying, and canning.

Exhibit of fruits and vegetables at the World's Fair, P. COLLIER (*New York State Sta. Rpt. 1893, pp. 173–176*).—A brief mention of the display sent by the station to Chicago, comprising 40 varieties of strawberries, 25 of currants, 167 of gooseberries, several of stone fruits, 17 of pears, 97 of apples, 154 of grapes, 433 of various vegetables, and specimens of sprayed and unsprayed branches and fruit. A list is given of the awards granted the station exhibits by the World's Fair Commissioners, and the exhibit made by the station at the State fair is summarized.

Laws of floral colors, E. M. BUDD (*Trans. Iowa Hort. Soc. 1893, pp. 53–56, fig. 1*).—A technical discussion of the subject, explaining the presence of special colors on chemical and physical grounds.

Hollies and their culture, J. MEHAN (*Cult. and Country Gent., 1895, Apr. 18, p. 308*).

Rose hybrids, J. L. BUDD (*Trans. Iowa Hort. Soc. 1893, pp. 359–361*).—Some brief notes on crossing roses, the hybrid seedlings being more vigorous than pure seedlings and blooming earlier.

Grafting the cacti, G. W. CARVER (*Trans. Iowa Hort. Soc. 1893, pp. 257–259*).—Notes on experiments in this line, cleft grafting and tongue grafting being most successful.

FORESTRY.

Conifers in the West, C. A. KEFFER (*Garden and Forest, 8 (1895), p. 182*).—Notes on red cedar, European larch, *Pinus resinosa*, arbor vitæ, spruces, and fir trees.

Rocky Mountain conifers, M. E. HINKLEY (*Trans. Iowa Hort. Soc. 1893, pp. 94, 95*).—A brief article treating of the manner in which some of the western evergreen trees were brought into public notice.

Four native trees in the Northwest, L. C. CORBETT (*Garden and Forest, 8 (1895), p. 173*).—Notes are given on the cottonwood, box elder, green ash, and white elm.

The European larch as a timber tree, N. A. REEVES (*Trans. Iowa Hort. Soc. 1893, pp. 176, 177*).—A brief note on a large planting of larches made some 20 years before, the trees being favorably regarded for their rapid growth, beauty, and timber value.

Evergreens for shelter belts, C. F. GARDNER (*Trans. Iowa Hort. Soc. 1893, pp. 90–92*).—The author advises the planting of evergreen trees as protection against winds, Norway spruces being especially recommended for the purpose.

Notes on rubber-yielding trees (*Bul. Bot. Dept. Jamaica, n. s., 2 (1895), No. 3, pp. 31–38*).

DISEASES OF PLANTS.

Field experiments with fungicides, B. D. HALSTED (*New Jersey Stas. Bul. 108, pp. 32, dgms. 2*).

Synopsis.—A report is given of field experiments with fungicides for the control of the diseases of turnips, cabbage, tomatoes, potatoes, and beans.

A preliminary report of this paper was read before the section on horticulture and botany of the Association of American Agricultural Colleges and Experiment Stations at its meeting in November, 1894, a brief abstract being given in E. S. R., 6, p. 267.

The experiments were conducted on an acre, equal portions of which were devoted to each crop. Diagrams are given of the area used in the experiments, showing the manner in which it was divided. Each of the one fifth acre portions, called series, was divided into 4 plats, and these in turn were divided into 6 equal belts. In this way adjacent portions of essentially the same character could be used for check and test experiments.

Experiments with turnips (pp. 6–14).—The soil selected was badly infected with the club root fungus (*Plasmodiophora brassicæ*), a badly affected crop of turnips having grown upon it the year before. Two crops of turnips were grown and before the seed was sown the soil received treatments of air-slacked lime, gas lime, kainit, and wood ashes in different amounts, and on the cultural belt accompanying every plat were used corrosive sublimate, Bordeaux mixture, and ammoniacal copper carbonate. In the treatment of the first crop the applications to the belts were as follows: Air-slacked lime 150, 75, and $37\frac{1}{2}$ bu. per acre; gas lime 75, $37\frac{1}{2}$, and $18\frac{3}{4}$ bu. per acre; kainit 1,920, 960, and 480 lbs. per acre; and wood ashes 150, 75, and $37\frac{1}{2}$ bu. per acre. The fungicides used were applied as follows: Corrosive sublimate, 960 gal. of a $\frac{1}{2000}$ per cent solution per acre; Bordeaux mixture, one half strength, 960 gal. per acre, and one half strength ammoniacal copper carbonate, 960 gal. per acre. In belt 4 the plants were sprayed once in 20 days with Bordeaux mixture. Where the full strength of lime was used much of the seed failed to germinate. The gas lime seemed to retard growth to a considerable degree, and kainit, in all strengths used, proved detrimental to germination. Wood ashes did not affect germination, and the plants growing in the belts receiving it grew more rapidly than the others. Five weeks after the seed was sown the presence of club root was shown to some degree and it spread rapidly from that time on.

The crop was harvested July 24 and it was found that the treatments gave almost wholly negative results in preventing club root. August 10 a second seeding was made, the soil having received treatment 4 days before, the proportions of the fungicides being somewhat modified. From the results obtained the author concludes as follows:

"Air-slacked stone lime gave sufficient evidence of its usefulness as a preventive of club root of turnips to warrant its being recommended for this purpose. When so employed it is advised that it be used at the rate of not less than 75 bu. per acre and applied at least 3 months previous to the time of planting.

"Gas lime, kainit, and ashes all failed to prevent the malady. Gas lime and kainit are both injurious to the crop.

"A half-strength solution of corrosive sublimate applied to the soil at the rate of 4,320 gal. per acre was not harmful to the plants and gave evidence of having materially diminished the amount of clubbing. Equal quantities of half-strength solution of Bordeaux mixture and ammoniacal copper carbonate proved of no value as club root fungicides and were decidedly injurious to the plants. Half-strength Bordeaux mixture applied to the foliage once in 20 days did not prevent turnip-leaf blight."

Experiments with cabbage (pp. 14–18).—The experiments with cabbage were conducted under the same conditions as the experiments above described for the turnips. The conclusions of the author are as follows:

"Air-slacked stone lime is a preventive of the club root of cabbage. The best results were obtained from the smallest application—that is, at the rate of 75 bu. per acre.

"Gas lime, kainit, and wood ashes are all equally ineffective as club root fungicides.

"A half-strength solution of corrosive sublimate at the rate of 2,160 gal. per acre can not be recommended, for although an apparent preventive of club root, the solution is destructive to the plants. A weaker solution might prove just as effective as a fungicide without interfering with growth.

"Neither half-strength Bordeaux mixture nor ammoniacal copper carbonate when used at the above rate diminished the amount of clubbing and both were very injurious to the plants."

Experiments with tomatoes (pp. 18–20).—In these experiments the object was to test the effect of various strengths and number of applications of Bordeaux mixture and ammoniacal copper carbonate required for the prevention of the various diseases affecting the tomato. Three strengths of solutions were used, and in testing the number of applications required from 2 to 8 sprayings were given the plants. Late in the season several diseases were noticed on sprayed and check plants, but not in any great abundance. The diseases were so poorly shown on the check plants that the results have little if any practical bearing. The experience of the author in staking tomato plants so as to raise the stem and branches clear of the ground led him to conclude that such treatment was not advisable.

Experiments with potatoes (pp. 20–24).—The fourth series of experiments was with potatoes, an effort being made to prevent scab by the use of different strengths and methods of application of corrosive sublimate and Bordeaux mixture. In the cultural belts the plants were sprayed for the prevention of leaf diseases, but so little disease was present on the checks as to render these experiments of little value.

At harvest the tubers were weighed and the weight of sound and scabbed potatoes ascertained. The author's conclusions as to the value of the treatment as shown by his experiments are as follows:

"Potatoes soaked in, and sprayed in the open rows with, quarter-strength corrosive sublimate gave a larger yield and a lower per cent of scab than did either of the belts treated with half and full strength solutions of the same compound. Similar results followed the treatment of seed potatoes with quarter-strength Bordeaux mixture.

"Although there was but little apparent difference in value between corrosive sublimate and Bordeaux mixture, the former is considered preferable on account of its being more easily prepared, and as it is of a uniform strength throughout admits of a much greater quantity of potatoes being treated at one time than does the Bordeaux mixture, which soon settles unless stirred.

"The cutting of the 'seed,' before soaking in Bordeaux mixture, showed very emphatically the importance of applying the fungicide to the uncut potatoes and preparing them afterwards for planting."

Experiments with beans (pp. 24–30).—Two crops of Golden Wax beans were grown in the last series, the object being to test different strengths and times of application of fungicides. Based on the results of his experiments with the beans, the author concludes that—

"Soaking bean seed in either full, half, or quarter-strength Bordeaux mixture does not prevent anthracnose.

"Spraying the vines with full-strength Bordeaux mixture or full-strength ammoniacal copper carbonate every 10 days is a partial preventive of anthracnose and bacterial blight, and when applied to the seedlings within a few days after their first appearance and repeated at intervals of 5 days is an almost complete preventive.

"Half-strength Bordeaux mixture and half-strength ammoniacal copper carbonate gave equally good results as leaf fungicides, and are preferable to the full or quarter-strength solutions of either of the above compounds. As fungicides they are as effective as the stronger solutions, and, unlike them, do not injure the vines. The quarter-strength solutions are less effective as fungicides."

The formulas for the fungicides used and methods for their preparation and application are given in detail.

Notes on finger and toe (club root) of cabbage and allied plants, G. MASSEE (*Proc. Roy. Soc., 57 (1895), No. 344, pp. 330–332*).—The author briefly refers to the observations of several authors on the disease of crucifers caused by *Plasmodiophora brassicæ* and gives an account of some experiments conducted by himself. He found (1) that in addition to cultivated plants, several weeds belonging to the order *Cruciferæ* are attacked by *Plasmodiophora*. Hence the necessity of preventing the growth of such weeds in fields, etc. (2) That the germs of disease remain in the soil and retain their vitality for at least 2 years. (3) The development of *Plasmodiophora* is favored by the presence of acids and checked by the presence of alkalies, in this agreeing with fungi rather than bacteria. (4) For the purpose of sterilizing infected soil, experiments prove that either a dressing of lime or a manure containing potash salts is effective, the last being most valuable, as it not only destroys the germs in the soil but arrests the disease in seedling

plants and at the same time supplies one of the ingredients necessary for the healthy growth of turnips, etc.

Treatment of melon diseases, F. A. WAUGH (*Oklahoma Sta. Bul. 15, pp. 30–32, fig. 1*).—Brief notes are given of anthracnose of watermelon, due to *Colletotrichum lindemuthianum*. In 1894 experiments were conducted for its repression. Seeds were soaked in Bordeaux mixture and copper carbonate solution before planting, and in a second trial the plants were sprayed at different intervals throughout the growing season. The results were wholly negative and the experiments are to be repeated.

Potato blight and potato scab, F. W. RANE (*West Virginia Sta. Bul. 38, pp. 39–46, figs. 5*).—A popular bulletin in which potato blight due to *Macrosporium solani* and potato scab are figured and described. The use of Bordeaux mixture is advised as preventive treatment for the blight and soaking seed potatoes in corrosive sublimate for the prevention of the scab. Notes are given on spraying apparatus and also list of firms making such machines.

The author tested the effect of barnyard manure and lime on the production of scab. The most scab was found in the plats receiving the manure, the plat receiving lime gave the next amount, lime and manure still less, and no treatment gave the least amount of scab. All the seed was untreated in this experiment.

Potato scab, J. TROOP (*Indiana Sta. Bul. 53, pp. 120–122, figs. 2*).—The author conducted some experiments to ascertain (1) whether or not the disease is developed more rapidly in muck soil than in sandy loam; (2) whether a single crop of scabbed potatoes will render the soil unfit for a future crop, and (3) the effect of treatment on the yield. The tubers were soaked in a solution of corrosive sublimate, 2 oz. to 16 gal. water, for 1, 1.5, and 3 hours. In every case the longer the seeds were soaked the less was the amount of scab. In the case of the muck soil there was a greater amount of scab on both treated and untreated plats than on the upland soil. In the muck the untreated plats gave 60 to 65 per cent scabbed tubers, as compared with 3.5 to 5.75 per cent for the treated plats. On the upland the amount of scab was reduced to 2 per cent by the treatment. The germs from an infected crop of the previous year materially increased the amount of scab at harvest. Owing to a frost killing some plants the third inquiry was abandoned, as the results were too unreliable for comparison.

Potato scab and its prevention (*Iowa Sta. Bul. 27, pp. 120–129, figs. 3*).—Compiled notes are given concerning the cause of potato scab, and suggestions are given for its prevention. Experiments were conducted to test the relative value of corrosive sublimate, ammoniacal copper carbonate, potassium sulphid, Bordeaux mixture, ferrous sulphate, soda hyposulphite, and a sulphur mixture for the prevention of scab. Owing to the season the results obtained were such that no definite conclusions could be drawn, but the corrosive sublimate was

thought to have given the best results, when total yield and per cent of scab are considered.

Ruta-baga rot, L. H. PAMMEL (*Iowa Sta. Bul. 27, pp. 130–134, pl. 1*).—An abstract of this article was presented to the section on botany and horticulture of the Association of American Agricultural Colleges and Experiment Stations at its meeting in November, 1894 (E. S. R., 6, p. 268).

The disease was first noticed in 1892 and in 1893 was so severe as to destroy in one case more than 50 per cent of the crop. When present this rot may be recognized by its peculiar odor. Usually the crown of the root is the portion first affected, but occasionally the bases of the leaves are first to show the disease, or it may appear on the side of the root. The leaves of all plants affected were spotted, but the author has not attempted to study the relationship between the leaf spotting and the rotting of the roots. The fibrovascular bundles of diseased roots become black and the adjacent parenchyma is of a watery appearance. In roots badly affected the cortex easily separates from the fleshy portion. Sometimes the stems and roots become hollow, containing an ill-smelling fluid. In this fluid numerous bacteria were found, some of which were isolated, and from inoculation experiments one was found that the author considers the cause of the disease. He has given to it the name *Bacillus campestris* n. sp., characterized as follows:

"Bacillus varying somewhat in length from 1.87 μ, 2.25 μ, to 3 μ, width uniform 0.37 μ. Rods rounded at ends, occurring singly or in chains of two or three, staining uniform and readily with fuchsin and gentian violet; in old cultures it stains with difficulty. In hanging drops the bacillus exhibits a lively motion. The organism has considerable vitality, cultures 4 months old growing readily when transferred. Spores not observed."

In the various cultures the bacteria produces a characteristic yellowish growth.

The disease affects ruta-bagas and yellow turnips. No specific suggestions are given for its prevention.

Observations on Plowrightia morbosa, S. A. BEACH (*New York State Sta. Rpt. 1893, pp. 686–688*).—During 1893 a plum nursery was examined at the request of its owner for black knot. The young trees were budded in 1891 and in 1893 no wood was left above the union but 2-year-old growth. One side of a block of the young trees was bordered by a row of bearing plum trees that were badly affected by the black knot, some of the branches of the diseased trees overhanging the nursery stock. In 1892, after the leaves had fallen, all knots were cut from the old trees. On June 28, 1893, nearly every young tree immediately under the old ones was badly affected, and a careful inspection showed some evidence of the disease in other rows. The conclusion of the author is that the infection undoubtedly came from the older trees there being no other adequate source of infection, and from the fact that the young trees under the drip of the older ones were the ones worst affected.

The author claims that the infection of the young trees could only have been through the conidia formed during 1892, as the old knots had been removed in the fall of 1892 before any ascospores were formed. This point is of economic interest in showing that a serious attack of the disease may follow from the conidia formed during the summer months as well as through the ascospores formed during the winter and early spring.

Spraying orchards and potato fields, L. R. JONES (*Vermont Sta. Bul. 44, pp. 81–102, figs. 14*).

Synopsis.—A report is given on the relation of weather of 1894 to plant diseases, apple and pear scab and the means for its repression, results of spraying potatoes in 1894, observations upon the date of planting potatoes, and on the prevention of potato scab.

Relation of weather of 1894 to plant diseases (p. 82).—Owing to the remarkably dry season of 1894 there were no serious attacks of parasitic fungi, some plants escaping almost entirely. While plant diseases were not troublesome the dry weather brought conditions resulting in unusual insect activity. The results shown on the sprayed plats, while not as marked as in previous years, still gave enough difference over the unsprayed crop as to indicate that spraying will be profitable.

Apple and pear scab (pp. 82–93).—Illustrated notes are given on the cause of apple and pear scab and the results of a series of experiments conducted for its repression are reported. Three varieties of apple trees and 1 of pears were sprayed with Bordeaux mixture, different lots of the trees receiving 4, 5, 6, and 7 applications. The results given showed that for that year 4 sprayings were sufficient. The gains as shown by the character of the fruit produced were 23, 24, and 27 per cent for the apples and 117 per cent for the pear trees. Directions are given for the preparation and application of the fungicide.

Results of spraying potatoes in 1894 (pp. 93–98).—Applications of Bordeaux mixture were given to the potato plants, but owing to the dry season but little disease was noticed. There were, however, severe ravages of grasshoppers and flea beetles. The use of the usual insecticides seemed to have little effect, but it was noticed that those plants which had been sprayed with Bordeaux mixture escaped serious injury. From the treated plats an increased yield over the check plats was secured, due no doubt to the combined fungicidal and insecticidal effect of the Bordeaux mixture. The author thinks he is warranted in recommending the use of Bordeaux mixture on either early or late varieties of potatoes during either a wet or dry season. Paris green may be added to the mixture for the destruction of the Colorado beetle.

Observations on the date of planting potatoes (pp. 98–100).—In the Annual Report of the station for 1893, p. 55 (E. S. R., 6, p. 908), the author called attention to the greater liability to disease of late planted potatoes. Ordinarily the early crop of potatoes is less productive than the later, owing to the fact of the tubers usually maturing in July, the driest month of the year, but in 1894 the season was so peculiar that

the early crop was the most productive. It is believed that for the average season late planting is the most profitable, in spite of the fact that the plants must be sprayed to protect them against the late blight.

Potato scab (pp. 100–102).—Brief notes are given on the cause of potato scab and recommendations given for its prevention. The author advises the use of clean seed, planting in clean soil, and the use of clean fertilizers. Where the seed potatoes are not known to be free from the scab it is suggested that they be soaked in a solution of corrosive sublimate before planting. After such a treatment the yield of merchantable potatoes in one of the author's experiments increased more than 50 per cent in 1894.

New species of parasitic fungi, S. M. TRACY and F. S. EARLE (*Torrey Bul., 22 (1895), No. 4, pp. 174–179*).—Descriptions are given of the following new species of parasitic fungi: *Puccinia notabilis* on *Pluchea borealis* (?), *P. paspali* on *Paspalum virgatum*, *Ustilago crus-galli* on *Panicum crus-galli*, *U. tonglinensis* on *Ischæmum ciliare* from India, *U. ornata* on *Leptochloa mucronata*, *U. pertusa* on *Setaria macrochæta* from Queensland, *U. pustulata* on *Panicum proliferum*, *Dimerosporium magnoliæ* on *Magnolia virginiana*, *Asteridium illicii* on *Illicium floridanum*, *Sphærella andromedæ* on *Pieris nitida*, *Lembrosia angustiformis* on *Ilex coriacea*, *L. prinoides* on the same, *L. illiciicola* on *Illicium floridanum*, *Vermicularia stachydis* on *Stachys affinis*, *Diplodia minuta* on *Tecoma radicans*, *D. sassafras* on *Sassafras officinale*, *Hendersonia taphrinicola* on blisters of *Taphrina* on *Quercus virginiana*, *Pestalozzia cliftoniæ* on *Cliftonia ligustrina*, *P. breviaristata* on *Tecoma radicans*, *Scolecotrichum punctulatum* on *Iris pabularia*, *Cercospora flexuosa* on *Diospyros virginiana*, *C. graminicola* on *Phleum pratense*, *C. hibisci* on *Hibiscus esculentus*, *C. mississippiensis* on *Smilax glauca* and *S. rotundifolia*, and *Tetraploa divergens* on *Panicum agrostidiforme*.

Grain smuts and potato scab, A. NELSON (*Wyoming Sta. Bul. 21, pp. 24, figs. 4*).—Popular illustrated notes are given on the cause and distribution of grain smuts and potato scab. Directions for the hot water and copper sulphate treatments are given and the former recommended as the more efficient treatment for the prevention of grain smut. For the potato scab soaking the seed tubers in corrosive sublimate is advised and the precautions to be observed in such treatment are mentioned.

Root rot of beets, HILTNER (*Sächs. landw. Ztschr.; abs. in Landw. Centbl. Posen, 23 (1895), No. 14, pp. 79, 80*).

The drooping disease of tomatoes, G. ABBEY (*Jour. Hort., n. s., 1895, No. 774, p. 360*).—A disease due to a slime fungus, *Plasmodiophora tomati*, is described. The treatment is the same as for club root of cabbage.

Diseases of the cherry, L. H. PAMMEL (*Trans. Iowa Hort. Soc. 1893, pp. 248–253*).—An account of the spot disease (*Cylindrosporium padi*), cherry and plum scab (*Cladosporium carpophilum*), cherry powdery mildew (*Podosphæra oxacanthæ*), and black knot (*Plowrightia morbosa*), the descriptions being in sufficient detail to be of value to working horticulturists.

Brunnisure of the vine, U. BRIZI (*Staz. Sper. Agr. Ital., 28 (1895), No. 2, pp. 112–128, pl. 1*).

A root rot of cyclamen, P. SORAUER (*Ztschr. Pflanzenkrank., 6 (1895), No. 1, p. 18*).—A disease caused by the mycellium of a fungus, probably *Thielavia basicola*, in the soil.

A disease of the violet (*U. S. Consular Rpt. 1895, Jan., p. 130*).

Parasitism of Agaricus melleus on oak roots, HARTIG (*Bot. Centbl., 52 (1895), No. 2, p. 48*).

Plant diseases, M. C. COOKE (*Gard. Chron., 17 (1895), pp. 496, 497*).—A lecture on plant diseases, their cause and means of repression.

The occurrence of Peronospora parasitica as influenced by the nature and development of the host plant, P. MAGNUS (*Ber. deut. bot. Ges., 12 (1894), Generalversammlungs number, 1895, Feb. 12, pp. 39–44, pl. 1*).

On the polymorphism of the genus Sporotrichum, E. BOULANGER (*Rev. gén. Bot., 7 (1895), No. 75, pp. 97–102; 76, pp. 166–170*).

Naphtholate of soda as a fungicide (*Prog. Agr. et Vit., 12 (1895), No. 16, pp. 422, 423*).

On combating grain rusts, W. SCHEUTLE (*Fühling's landw. Ztg., 44 (1895), No. 4, p. 131*).

On the prevention of injuries to grain, STEGLICH (*Landw. Jahrg., 3 (1895), No. 8, p. 44*).

When to spray (*Amer. Gard., 16 (1895), No. 38, pp. 180, 181, figs. 5*).—Extracts are given of New York State Station Bulletin 84.

Preventing leaf blight of plum and cherry nursery stock, S. A. BEACH (*New York State Sta. Rpt. 1893, pp. 688–693, pls. 2*).—A reprint of Bulletin 72 of the station (E. S. R., 6, p. 302).

Experiments in preventing pear scab, S. A. BEACH (*New York State Sta. Rpt. 1893, pp. 694–717, pls. 3*).—A reprint of Bulletin 67 of the station (E. S. R., 5, p. 986).

ENTOMOLOGY.

Insect Life (*U. S. Dept. Agr., Division of Entomology, Insect Life, vol. VII, No. 4, pp. 281–360, figs. 7*).—*Special notes* (pp. 281, 282).—These comprise remarks on the new cotton-boll weevil, Florida insects and the December freeze, and Bulletin 33, Division of Entomology.

Further notes on the San José scale, L. O. Howard (pp. 283–295).—A general résumé of the information on this pest, comprising notes on its life history, distribution, original home, future, and remedies. It is stated that the insect does not lay eggs, but is viviparous, the females continuing to give birth to living young for several weeks. It is believed that there are 5 annual generations in the latitude of Washington. *Aphelinus fuscipennis* is the only parasite which has so far been found in the East. The belief is held that the origin of the scale is in Australia. Spraying with a strong solution of whale-oil soap or a very strong resin wash is the only means that has proved effectual as a remedy, but the expense involved will probably interfere with its general adoption.

Report on the Mexican cotton-boll weevil in Texas, C. H. T. Townsend (pp. 295–309).—A report on the life history of *Anthonomus grandis* and the injury inflicted by it on the cotton crop in Texas. Both the larvæ and adults were found to feed on the cotton bolls, the eggs usually being deposited in the unopened flower buds. The weevil infested Texas from the adjacent State of Coahuila, Mexico, and now occupies the extreme southern portion of Texas, keeping near to the coast and extending from Brownsville to San Antonio, or about one sixth of the cotton producing region of the State. It is estimated that a loss of 90 per cent of the cotton crop in the infested region was caused by the weevil in 1894. Burning over all infested fields during the winter, followed by flooding them for a week or two, and rotation of crops for at

least 2 years is recommended. It is thought that arsenical spraying when the bolls begin to form may be advantageous. It is urged that cotton raising be abandoned along the southern Texas border to prevent further importation of the weevil, and that legislation be made providing for quarantine measures.

The cotton or melon plant louse, T. Pergande (pp. 309–315).—Bibliographical notes on *Aphis gossypii*, establishing its identity with the orange, melon, and cucumber aphides. A long and varied list of food plants is given and technical descriptions of the pupæ and adult females.

The cotton worm question in 1894, E. A. Schwarz (pp. 315–320).—Notes on the methods adopted throughout the cotton region for combating the cotton worms, the preferred method at present being dusting the plants with Paris green applied by means of sacks attached to a pole on the back of a horse or mule.

Notes on cotton insects found in Mississippi, W. H. Ashmead (pp. 320–326).—A continuation of previous papers. In this installment the Hemiptera, Lepidoptera, and Diptera are treated.

On the distribution of certain imported beetles, F. H. Chittenden (pp. 326–332).—Notes on 18 species of the beetles attacking stored grains, vegetables, dried fruits, and drugs.

Injurious insects and commerce, L. O. Howard (pp. 332–338).—A general paper on the subject, treating briefly of several more injurious insects, chiefly imported, and urging the importance of attentive and watchful study of economic insects and the passage of quarantine laws.

Is Cyrtoneura cæsia an injurious insect? D. W. Coquillett (pp. 338, 339).—A note on the occurrence of this European insect in squash roots in Colorado, where it is believed the flies were present as scavengers.

Insect fertilizers of an aroid plant, H. G. Hubbard (pp. 340–345).—Illustrated notes on the fertilization of the flowers of *Philodendron* sp. in Montserrat by the beetle *Macrostola lutea*, which burrows through the spathe to deposit its eggs upon the spadix, where the flowers are by this means fertilized with pollen from other plants of the species.

Notes and observations on the twig girdler, C. H. Scheffer (pp. 345–347).—An account of the methods employed by *Oncideres cingulata* in laying its eggs and girdling the twigs.

A Cecidomyid that lives on poison oak, D. W. Coquillett (p. 348).—Technical description of *Cecidomyia rhois*, a new species forming galls on the roots of *Rhus toxicodendron*.

A migration of cockroaches, L. O. Howard (p. 349).—A brief note on the migration of several thousand egg-bearing croton bugs (*Ectobia germanica*) from an old restaurant to other buildings.

The potato-bud weevil, F. H. Chittenden (pp. 350–352).—Brief observations on the life history of *Anthonomus nigrinus*, which deposits its eggs

in the buds of horse nettles and potatoes. It is believed to be single brooded.

An ortalid fly injuring growing cereals (pp. 352–354).—Notes on the life history of *Chætopsis ænea*, which burrows in the stem of wheat, oats, corn, and sugar cane to a varying extent.

The gray hair-streak butterfly and its damage to beans (pp. 354, 355).—An illustrated note on *Uranotes melinus*, the larva of which has been discovered feeding upon beans, chiefly Limas. The injury has not been serious.

Among *general notes* and *notes from correspondence* may be mentioned the following: A home-made cover for fumigation with bisulphid of carbon, the imported parasite of the Hessian fly, a remarkable migration of butterflies, are tumblebugs beneficial? Margarodes in the United States, the scale insects of Arizona, larvæ in mincemeat, a lachnosterna damaging wheat in Texas, spread of *Cryptorynchus lapathi*, new food plant for the San José scale, the new plum aspidiotus in Illinois, and the Florida red scale in a northern greenhouse.

A preliminary list of the honey-producing plants of Nebraska, C. E. BESSEY (*Nebraska Sta. Bul. 40, pp. 141–152*).—This consists of a list of 157 species of native and introduced plants, yielding nectar, and in many cases pollen as well. It is not stated that hive bees visit all of the flowers included, and the list is undoubtedly far from complete, but it is valuable as being the most extensive list of this nature yet published.

The chinch bug, O. LUGGER (*Minnesota Sta. Bul. 37, pp. 153–182, figs. 12*).—This is a popular bulletin issued for the information of farmers on account of threatened damage by chinch bugs, and treating rather fully of the appearance and life history of the pest, especially mentioning vulnerable points in its habits and its diseases and insect enemies. Directions are given for identifying the chinch bug, particularly by means of the black spots on the white wing covers, and descriptions and figures of the insects most frequently confused with it. The subject of fungus diseases is treated of at length, their action being described in detail, and directions given for their propagation and application to the bugs.

Clean cultivation is urged as a preventive, and in case of an invasion active measures by means of digging ditches into which the bugs may fall during their migrations and can be destroyed by burning; spraying with kerosene emulsion when only the edge of a field is attacked is also advised, but the most confidence is placed in fungus diseases, especially if the weather be damp.

The fruit bark beetle, Scolytus rugulosus, J. TROOP (*Indiana Sta. Bul. 53, pp. 126–130, figs. 7*).—Illustrated descriptive, life history and remedial notes on this fruit pest that has recently begun attacking fruit orchards in Indiana. Apple, pear, plum, peach, and cherry trees

seem to be attacked in preference, although various shade and ornamental trees are also infested. The eggs are laid in September by the female burrowing under the bark of the trunk and larger branches, forming little channels where the larvæ feed and hibernate, emerging as adults in early spring. There is a second brood in the summer. The insect was discovered attacking both healthy and diseased trees.

It was found that spraying the trunks and branches with kerosene emulsion, as well as with a combination of Bordeaux mixture and Paris green, prevented the attacks of the beetle over the portion sprayed. Spraying with either of these remedies is therefore recommended, the application preferably to be made before any marks of attacks by the insects are found on the trees. Where trees are severely infested cutting them down and burning them through the winter is advised.

A plum scale in western New York, M. V. SLINGERLAND (*New York Cornell Sta. Bul. 83, pp. 681–699, pl. 1, figs. 4*).—This contains the results of investigations on a supposedly new species of scale insect belonging to the genus *Lecanium*, which has suddenly developed in alarming prevalence in the plum orchards of the State. Notes are given on the appearance of the pest, its life history, damage, enemies, and the most advantageous remedies. The minute, brown, spindle-shaped young scales that have survived the winter on the branches begin to move about April 1, soon locating themselves permanently, increasing rapidly in size, and becoming adult in about 2 months. The adult females are dark brown and almost hemispherical, resembling small brown split peas adhering to the branches, on which white scars are left on the removal of the scales. The males are smaller, flat, elongate, and whitish. Several hundred eggs are laid by each female in June, hatching in about a month, and the young migrate in August and September to the spots where they hibernate. There is but one annual brood.

The damage done by the scales is chiefly confined to plums, although other trees are attacked when adjacent to infested plum trees. The Japanese varieties of plums are apparently exempt from attack.

The twice-stabbed ladybird (*Chilocorus bivulnerus*) feeds upon the scale, both in its larval and adult state, and it is thought that there are also hymenopterous parasites.

Spraying with strong kerosene emulsion about July 1, when the newly hatched scales are detected moving about on the branches, is urged, the application to be repeated during the winter and again in the early spring.

A plate is given illustrating the San José scale for comparison with the plum scale.

Observations on insects—season of 1894, H. OSBORN and C. W. MALLY (*Iowa Sta. Bul. 27, pp. 135–149*).—This bulletin comprises notes on the chinch bug, western onion thrips, squash borer, and melon

louse, and was in great part presented before the section on entomology of the Association of American Agricultural Colleges and Experiment Stations at its meeting in Washington in November, 1894 (E. S. R., 6, p. 265).

The chinch bug was destructive over much of the State, and especially so in the southeastern portions. An extended drought the preceding year assisted in the outbreak by favoring the hibernation of the bugs. Wheat, barley, rye, oats, and corn were all attacked to varying extents. The most damage was done where winter wheat had been cropped for some years before, and it is believed that the bugs were favored in their hibernation by the presence of osage hedges. Experiments with the chinch bug fungus diseases were not altogether satisfactory, although they were successful in a number of cases. Energetic treatment is urged to avoid extensive damage this year. Burning over every possible place for hibernation in the fall and early winter is advised, and the plowing of dusty furrows about the fields liable to be attacked. Planting trap strips of grain to attract the bugs, where they may be destroyed by spraying with kerosene emulsion, is also advised.

The western onion thrips (*Thrips alii*) was quite destructive in the State, feeding also upon various other plants besides onions. Several generations developed during the year, attacking the plants by gouging or corroding the surfaces of the stems and causing the leaves to wilt and droop. The insects collected in the axils of the leaves, where they were sheltered, and the eggs were deposited in the leaf substance. Spraying with kerosene emulsion, as soon as the young thrips are hatched, is advised, a second and third application to be given at intervals of from 3 to 5 days. The use of bisulphid of carbon was successful, but possesses drawbacks in the way of trouble and time involved. Destruction of the onion tops by burning as soon as the crop is harvested, is advised. Another allied species of thrips also appeared and caused some slight damage.

The squash borer is described and its life history briefly given. Heavy fertilizing, planting of extremely early and late varieties, collecting the moths by hand in the evenings, destroying badly infested vines, and covering the basal joints of the vines with earth are recommended as remedial measures.

The melon louse was quite damaging throughout the State, destroying many acres of melons and cucumbers, chiefly in August. Its life history is briefly noted, and spraying with diluted kerosene emulsion is recommended, the vines being lifted and the spray applied to the under surface of the leaves as well as to the upper. Experiments were made with different quantities of bisulphid of carbon, applied against the lice for varying times, and the details and results are tabulated. The insecticide was evaporated from small watch glasses or shallow tins

placed by the plants, which were covered severally with washtubs, hay caps, and muslin. The muslin coverings proved insufficient to retain the fumes and the general results of the experiments were not altogether satisfactory, in several instances the lice surviving exposure to the fumes for an hour. Experiments were also made with hydrocyanic acid gas, generated in a small dish, and the plants covered for varying lengths of time. These experiments were very successful and the treatment is recommended for effectiveness and cheapness.

The use of bisulphid of carbon and hydrocyanic acid gas on low-growing plants, H. GARMAN (*Kentucky Sta. Bul. 53, pp. 144–150. fig. 1*).—An account of experiments with the above chemicals on the melon louse and rose aphis. The carbon bisulphid was used by introducing a tablespoonful of the fluid under a tub inverted over a melon hill, which was left undisturbed for about an hour and a half. By this means the majority of the aphides were killed, while the vines were not injured. In experiments with hydrocyanic acid gas a small cloth tent 3 ft. in diameter at the bottom and about 3 ft. high was used. This was supported by means of stakes over the plants to be treated, and beneath it was placed a saucer containing 9 cc. of water and 3 cc. of commercial sulphuric acid. To this 3 gm. of potassium cyanid was added. It was found that 4 minutes was a sufficient length of time to kill all insects present, with the exception of mites, and the method is recommended as being quick and effective for exterminating insects on single plants. A rosebush infested with the rose aphis was sprayed with antinonnin, 1 gm. to 1 qt. of water, but the lice were not completely destroyed. Hydrocyanic acid gas was then applied for 10 minutes, killing the insects, but also injuring the leaves of the plant.

The use of arsenites on tobacco, H. GARMAN (*Kentucky Sta. Bul. 53, pp. 125–143, figs. 6*)—This paper was in main part read before the section on entomology of the Association of Agricultural Colleges and Experiment Stations at its meeting in Washington in November, 1894 (E. S. R., 6, p. 265). In addition to the paper as there presented is given a discussion of various forms of apparatus for spraying tobacco, 5 of them being figured. A cart sprayer is believed to be best, but for ordinary purposes some form of knapsack sprayer is recommended, preferably one with a force pump attachment. A nozzle that causes the poison to issue in a fine mist is to be preferred. Spraying with 1 lb. of Paris green to 160 gal. of water is advised, to be first done about July 4 and followed by about 2 subsequent applications at intervals of 2 weeks. At least 2 weeks must elapse between the last spraying and the cutting of the plants.

Spraying for codling moth, H. GARMAN (*Kentucky Sta. Bul. 53, pp. 119–125, fig. 1*).—The results of experiments in spraying apple trees with arsenicals to determine their value as effective means of combating the codling moth. Two trees of Janet, about equal size, were

selected for the experiment, and one was sprayed 6 times with arsenical mixtures, once with London purple, and 5 times with Paris green, the applications beginning in July and continuing until after August 27. The adjoining tree was left untreated as a check. The apples which fell to the ground from both trees were picked up on 5 different dates and examined with reference to injuries by the codling moth and rot. From the sprayed tree were examined 834 fallen apples, of which only 19 per cent were free from rot. Of the rotten apples 67 per cent were injured by the codling moth, while 82 per cent of those not rotting were infested. Of the fallen apples from the check tree 27 per cent were rot free, of which 96 per cent were injured by the codling moth, while of the rotted apples but 92 per cent were damaged. Eight hundred and seventy-four apples were picked from the sprayed tree, of which 68 per cent were damaged by the codling moth, while of 816 apples picked from the check tree 81 per cent were injured by the insect.

The conclusions drawn are in favor of spraying with arsenicals for the moth, though the rot fungus is apparently not affected by the application. It is believed from the evidence that the codling moth avoids rotting apples. Apples from the sprayed tree were carefully analyzed by the chemist of the station, but no perceptible quantity of arsenic was discovered.

Insecticides, A. N. CAUDELL (*Oklahoma Sta. Bul. 15, pp. 29, 30*).—Notes on experiments against the squash bug (*Anasa tristis*) with various insecticides, using a combination of pyrethrum powder and kerosene emulsion, and also some odoriferous substances, namely, emulsions of the oils of tansy, cajeput, savin, and eucalyptus. Dusting the plants with lime and pyrethrum was also tried, but none of the remedies were effective.

Household pests, G. H. PERKINS (*Vermont Sta. Bul. 43, pp. 73–78, figs. 4*).—This consists of illustrated descriptive, life history, and remedial notes on the buffalo beetle (*Anthrenus scrophulariæ*), pitchy carpet beetle (*Attagenus piceus*), and clothes moths (*Tinea pelionella, T. bisselliella*, and *T. tapetzella*). Benzin and bisulphid of carbon are recommended against all of the species.

Cabbage gall insect (*Gard. Chron., 17 (1895), p. 500, fig. 1*).—Description of *Centiorhynchus sulcicollis*, for which applying gas lime in autumn is recommended.

The reappearance of Pieris protodice, J. A. MOFFAT (*Rpt. Ent. Soc. Ontario 1894, pp. 61, 62*).—Mention of the occurrence of this species in Ontario, where for a number of years it has been superseded by *Pieris rapæ*, with a discussion of the causes of its previous disappearance.

Phylloxera of the vine, A. DESPEISSIS (*Agl. Gaz. N. S. Wales, 6 (1895), No. 1, pp. 13–29, figs. 31*).—The life history of the insect and remedial measures are discussed.

The leaf folder and leaf skeletonizer, H. OSBORN (*Trans. Iowa Hort. Soc. 1893, pp. 174–176*).—Brief notes on *Teras minuta* and *Pempelia hammondi*, spraying with the arsenites being advised.

The gypsy moth, J. FLETCHER (*Rpt. Ent. Soc. Ontario 1894, pp. 67–72, figs. 4*).—A popular discussion of the insect, its life history, damage, and remedies, with an account of the methods employed against it in Massachusetts. Spraying with arsenate of lead is chiefly recommended.

Catastega aceriella, T. W. FYLES (*Rpt. Ent. Soc. Ontario 1894, p. 46*).—Description of the adult form of this maple moth, with brief notes on its habits.

An attack of Ephestia interpunctella, H. A. STEVENSON (*Rpt. Ent. Soc. Ontario 1894, p. 57*).—A brief note on the larva of this moth feeding on raisins. The attack was checked by the use of carbon bisulphid.

Pitcher plant moth, J. FLETCHER (*Rpt. Ent. Soc. Ontario 1894, pp. 44–46*).—Descriptive and life history notes on *Exyra rolandiana*.

Notes on a few Canadian Coleoptera, H. HARRINGTON (*Rpt. Ent. Soc. Ontario 1894, pp. 47–49*).—Brief notes on 21 species of beetles, several of economic value being among the number.

The San José scale, J. FLETCHER (*Rpt. Ent. Soc. Ontario 1894, pp. 73–76*).—Concise descriptive, life history, and remedial notes on *Aspidiotus perniciosus*, kerosene emulsion being given as the best remedy.

Injurious fruit insects of the year 1894, J. FLETCHER (*Rpt. Ent. Soc. Ontario 1894, pp. 76–81, figs. 7*).—Notes on a number of insects that were especially injurious in Ottawa the past season, particular mention being made of the pear tree psylla (*Psylla pyricola*), the apple cigar-case bearer (*Coleophora fletcherella*), an otiorhynchid (*Anametis grisea*), and the spotted paria (*Paria sexnotata*). The psylla was injurious for the first time and is recommended to be treated by means of kerosene emulsion.

Critical catalogue of the myrmecophilous and termitophilous Arthropods, E. WASMANN (*Berlin: F. L. Dames, 1894*).—An important work on the subject in all its bearings.

Kerosene attachment for knapsack spray pumps, H. E. WEED (*Garden and Forest, 8 (1895), p. 187, fig. 1*).

The economic value of parasites, F. M. WEBSTER (*Rpt. Ent. Soc. Ontario 1894, pp. 58–61, figs. 3*).—This paper was read before the section on entomology of the Association of American Agricultural Colleges and Experiment Stations at its meeting in 1894 (E. S. R., 6, p. 266).

Psilura monacha and its bacteria, A. METZGER and N. J. C. MÜLLER (*Mundener Forstliche Hefte. Berlin: J. Springer, 1895*).

Sixth annual meeting of the Association of Economic Entomologists (*Rpt. Ent. Soc. Ontario 1894, pp. 82–112*).—An abridged account of the proceedings and papers of the meeting, some of the papers, however, being printed in full. The proceedings were published at length in Insect Life, vol. VII, No. 2 (E. S. R., 6, p. 650).

FOODS—ANIMAL PRODUCTION.

Miscellaneous analyses of feeding stuffs, H. SNYDER (*Minnesota Sta. Bul. 36, pp. 129–145*).—The averages are given for analyses made at the station of the following materials, and calculation of the digestible materials in the same: Clover hay, pea hay, vetch, timothy hay, blue grass hay, millet, mixed prairie hay, upland prairie hay, blue joint hay, sedge grass, oat hay, corn fodder, wheat straw, oat straw, barley straw, clover straw, green rape, pasture grass, green clover, corn silage, sugar beets, mangel-wurzels, millet seed, barley, corn, oats, peas, rye, wheat, "goose" wheat, flaxseed, corn meal, corncobs, cotton-seed meal, gluten meal, germ meal, linseed meal, oat feed, wheat bran, wheat shorts, wheat germ, wheat flour, wheat screenings, and cockle bran.

An explanation is given of the terms used, the method of calculating the nutrients in a ration, and the fuel value of feeding stuffs. The

amounts of nutrients furnished by one dollar's worth of a variety of feeding stuffs at local prices is shown in the following table, which is taken from the bulletin:

Digestible nutrients and heat units bought for one dollar.

Kind of feeding stuff.	Price.		Digestible nutrients.				Fuel value.
	Per ton.	Per bushel.	Dry matter.	Protein.	Ether extract, mainly fat.	Nitrogen-free extract and fiber.	
			Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Calories.*
Bran	$12.00		100	20	6	71	194,610
Bran	15.00		80	16	5	56	155,045
Corn meal	18.00		87	10	3	74	168,915
Corn meal	12.00		132	15	5	112	257,345
Corn and cob meal	15.00		100	10	3	86	191,235
Corn, shelled		$0.50	87	9	3	75	168,915
Wheat shorts	12.00		111	17	4	90	216,029
Wheat shorts	16.00		85	12	3	70	165,195
Oats		.30	72	10	4	56	139,760
Linseed meal	28.00		51	19	5	24	91,105
Linseed meal	24.00		59	23	6	28	120,210
Barley		.48	71	9	2	59	134,930
Peas		1.00	48	12	3	36	101,955
Peas		.70	68	16	4	49	137,900
Gluten meal	22.00		71	22	6	43	146,250
Cotton-seed meal	28.00		47	23	7	14	97,395
Wheat		.50	87	14	2	70	155,987
Timothy hay	8.00		127	9	3	108	230,295
Prairie hay	6.00		163	11	4	138	294,040
Clover hay	10.00		105	15	3	82	193,095
Millet hay	8.00		138	10	3	121	256,236
Rye		.45	88	13	2	72	166,550

Popular information is given for using the above table in selecting feeding stuffs, and remarks on the factors which influence the composition of crops. Under the latter topic analyses are given of timothy cut at 3 different stages to show the effect of stage of growth on composition. A sample of timothy weighing 25 lbs. was exposed to 1 heavy shower and 3 heavy dewfalls. At the end of 5 days the hay weighed 21.5 lbs. The percentage of each nutrient lost by exposure was, ash 17.26, fat 7.47, protein 7.69, fiber 0.20, nitrogen-free extract 25.78. "The rain removed 12 per cent of the best part of the dry matter of the hay. . . In actual haymaking the loss would have been larger, because some of the hay would have been lost mechanically."

The digestibility of wheat, H. SNYDER (*Minnesota Sta. Bul. 36, pp. 146–148*).—The digestibility of wheat was determined by feeding it to young pigs (1) whole in connection with cracked corn and (2) cracked in connection with corn. Only the average results of the trials are given, which are as follows:

Digestion coëfficient for whole and cracked wheat fed to pigs.

	Whole wheat.	Cracked wheat.
	Per cent.	*Per cent.*
Dry matter	72	82
Ash	44	50
Ether extract (fat)	60	70
Protein (gluten)	70	80
Fiber	30	60
Nitrogen-free extract	74	83

"The results show a difference of 10 per cent digestibility in favor of the cracked wheat. Had the wheat formed more than half of the ration, the difference in digestibility would undoubtedly have been even greater.

"[The above coëfficients are compared with those for cracked barley, wheat, shorts, wheat bran, and cracked corn.]

"The digestibility of cracked wheat compares very favorably with other grains. It does not appear to be quite as digestible as corn, but the dry matter is more digestible than that of barley, shorts, or bran."

When the wheat was fed whole some of the kernels passed the animals undigested. These kernels were washed in distilled water and analyzed, the result being compared with the composition of the wheat as fed.

"The only noticeable difference is about 2½ per cent more water in the wheat recovered from the manure. When the results are compared on the basis of the dry matter the difference in composition between the 2 samples is very slight."

The digestible dry matter and nutrients in a bushel of wheat and of corn are compared as follows:

Digestible nutrients in a bushel of wheat and corn.

	Dry matter.	Fat.	Protein.	Carbohydrates.	Fuel value.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Calories.*
Wheat	43.5	1.0	7.0	35.0	82,345
Corn	43.5	1.5	4.5	37.5	84,407

"When wheat and corn are both selling at 50 cts. per bushel the 50 cts. will purchase the same amount of digestible dry matter of either wheat or corn, but the digestible dry matter in the bushel of wheat contains 2½ lbs. more of digestible protein, while the bushel of corn contains 2½ lbs. more of digestible carbohydrates. The amount of heat units produced by each grain is about the same. . . .

"Furthermore, the manure from the wheat is worth about 25 per cent more than the manure from the corn."

Corn on the cob and corn meal, W. P. WHEELER (*New York State Sta. Rpt. 1893, pp. 235–237*).

Synopsis.—A comparison of corn meal with ear corn on 2 lots of 4 pigs, lasting 63 days. The lot on corn meal made the larger and more economical gain, both financially and for the dry matter eaten.

Eight pigs, Poland China-Duroc cross, weighing about 110 lbs. each, were divided into 2 lots with 2 sows and 2 barrows in each. Both lots received the same amount of a grain mixture (5 parts wheat bran, 3 of cotton seed meal, 1 of linseed meal, and 1 of middlings), and in addition one lot had all the ear corn it would eat and the other lot had an equivalent amount of corn meal. Eighty-nine per cent by weight of the ear corn was kernels. The trial lasted from February 13 to April 17, being divided into 2 periods. The average results follow:

Comparison of corn meal with ear corn on pigs.

Lot.	Food.	Average daily gain in weight.	Food eaten per 100 lbs. live weight per day.		Dry matter eaten per pound of gain.	Cost of food per pound of gain.
			Total.	Dry matter.		
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Cents.*
E	Corn meal:					
	First period	0.75	2.48	2.06	2.75	3.43
	Second period	.70	2.21	1.84	2.63	3.26
F	Corn on the cob:					
	First period	.56	2.65	2.27	4.05	4.11
	Second period	.48	2.22	1.90	3.96	3.96

In estimating the cost of food corn is rated at $15 and corn meal at $20 per ton.

"At the close of the trial the average weight for lot E was 173.4 lbs. and for lot F 155 lbs. The gain made by lot E cost for the first period 16.5 per cent less than that made by lot F and during the second period 17.7 per cent less."

Is it advantageous to feed wheat and rye instead of the bran from the same? A. EMMERLING and P. JENSEN (*Landw. Wochenbl. Schles. Holst., 44 (1894), Nos. 45, pp. 619, 620; 48, pp. 667, 668; 49, pp. 684, 685*).—A controversy as to whether it is most advantageous from a financial standpoint to sell wheat and rye and buy bran for feeding. Emmerling, in the first paper, calculates the value of the digestible nutrients in wheat and bran and concludes that with wheat at 86 cts. per bushel and bran at about $17.25 per ton, the Hamburg prices, it is advisable to sell wheat and buy bran, and states that the same would apply to rye. Jensen criticises his taking Hamburg prices instead of Kiel, and contends that at the local prices for wheat and bran the calculations show the farmer can better afford to feed his wheat than to draw it to market and buy bran.

Emmerling recalculates the values on the basis of prices at a number of points and insists that farmers reasonably convenient to depots are warranted in selling the grain and buying bran.

The source of fat in milk, P. COLLIER (*New York State Sta. Rpt. 1893, pp. 156–173*).—This article opens with a discussion of the mechanism and chemistry of digestion, and of the theories of the formation of fat from albuminoids in the food. Data for the fat in the food and in the milk in the 90-day breed test at the World's Fair are presented, of which the following is a summary:

Fat in food and in milk in World's Fair breed test.

Breed of animals.	Fat eaten.	Fat digested.	Fat in milk.
	Pounds.	*Pounds.*	*Pounds.*
Jerseys	3,884.2	2,706.2	3,516.1
Guernseys	3,756.6	2,486.2	2,784.6
Shorthorns	4,101.1	2,932.6	2,410.0
Total	11,741.9	8,125.0	8,710.7

"It appears that there was upon an average 7.2 per cent more fat recovered in the milk than was digested in the food fed."

The total and digestible fat were calculated from average figures for composition and digestibility of the feeding stuffs used. It is calculated that had the percentage of digestible fat in the concentrated food been 0.38 per cent higher "it would have been sufficient to meet all the demands upon the animals for the fat produced in the milk and the increase in live weight of the animals during the trial."

The results for 1893 of the test of breeds at the station are next cited. It is shown that 23 cows in their first period of lactation, 18 in their second, and 10 in their third consumed the following amounts of food nutrients and produced the following amounts of fat in milk:

Food nutrients eaten and fat produced in milk.

Number of cows.	Period of lactation.	Nutrients eaten.				Fat produced in milk.
		Albuminoids.	Carbohydrates.	Crude fat.	"Pure" fat.	
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
23	First	22,911.20	113,388.10	9,958.90	8,226.10	6,810.20
18	Second	14,063.10	68,023.70	6,454.70	5,331.60	4,363.20
10	Third	6,733.60	30,964.70	3,166.50	2,615.50	2,272.00
	Total	43,707.90	212,556.50	19,580.10	16,173.20	13,445.40
	Ratio	3.25	15.81	1.46	1.20	1.00

"There was during these three periods an average increase of 161 lbs., or a total of 3,134 lbs. in the live weight of the animals under experiment, and if we assume the estimate of 8.7 per cent as the amount of fat represented in this gain it will amount to 272.7 lbs., which, added to the fat of the milk, will give 13,718.1 lbs. as the fat produced by these animals.

"If now we allow the crude fat of the food to contain 17.4 per cent of impurities, there would remain 82.6 per cent, or 16,173.2 lbs. of pure fat in the food eaten by these animals, or 18 per cent more fat than was produced by them in their milk or increase in weight. This will present a loss of 15.3 per cent of the pure fat through lack of digestibility, a loss greater than appears to exist in many experiments made. . . .

"It would seem that until strong proof shall be submitted that the fat of milk is derived from other constituents of the food its source at present must be held as the fat present in the food of the animal.

"It is proposed to make other experiments the coming season to clear up this point, if possible."

Effect of fat on the utilization of the albuminoids of the food, R. LAAS (*Ztschr. physiol. Chem., 20, No. 3, pp. 233–248*).—In 2 experiments dogs were fed on horse flesh freed from fat as far as possible, a quantity of fat being added to this in a second period. The results are believed to warrant the conclusion that the utilization of the albuminoids of the food is increased by the addition of fat—*i. e.*, more nitrogen was stored in the body on a constant ration of nitrogen when fat was added. Accompanying this no diminution in the decomposition process in the intestines could be detected. In this respect the action of fat is unlike that of carbohydrates, which have been found to materially decrease the splitting up of the albuminoids in the intestines.

On the question of the formation of fat from albuminoids in the animal body, M. KUMAGAWA (*Mitt. med. Fac. k. Jap. Univ., Tokyo, 3 (1894), p. 1; abs. in Chem. Ztg., 19 (1895), No. 16, Repert., p. 58*).—The author's experiments were on dogs. They indicated that the animal body is not capable under normal conditions of forming fat from albuminoids. When albuminoids are fed in such large quantity that they alone more than fulfill all the food requirements of the animal, the decomposition of the nitrogen-free materials of the food nearly ceases, and the fat and the carbohydrates of the food are almost completely stored in the body as fat.

Soiling crops, 1894, J. WILSON (*Iowa Sta. Bul. 27, pp. 85–104*).—To test the value of a number of soiling crops, 6 cows, including 2 Holsteins, 2 Shorthorns, and 2 Red Polls, were fed from June 28 to August 28 a basal ration of 5 lbs. of hay and 9 lbs. of corn-and-cob meal per head daily, to which the following green crops were added in separate periods of 7 or 8 days: Peas and oats, red clover, fodder from sweet corn, soja bean, and cowpea. The supply of cowpea was so small that only 2 cows (Holsteins) could be fed upon it. The analyses are given of the soiling crops used, and tests of the composite samples of the milk. Data are also given for the yield of milk and butter, and the flavor, volatile fatty acids, and melting point of the butter produced on each soiling crop. The results are summarized below:

Average results with soiling crops.

Soiling crop.	Yield of milk.	Fat content.	Yield of fat.	Yield of butter.	Qualities of butter.		
					Flavor on basis of 45.	Volatile acids.	Melting point.
	Pounds.	*Per cent.*	*Pounds.*	*Pounds.*		*Cc.*	*Deg. C.*
Peas and oats	160	2.78	4.42	5.16	43	29.95	32.20
Red clover	155	2.96	4.59	5.35	43	29.90	32.60
Corn fodder	134	2.64	3.52	4.10	45	....	....
Soja bean	130	3.08	3.99	4.65	45	28.95	33.00
Cowpea (cows Nos. 115 and 213)	54	3.16	1.69	1.97	43	28.70	32.50
Corn fodder (Nos. 115 and 213)	54	2.17	1.49	1.73	....	....	....

As the cowpea was fed to only 2 cows, the data are given for these 2 cows while receiving corn fodder, for comparison.

"The soja bean makes butter of a superior flavor; the creamery experts pronounced it equal to butter from corn. . . .

"The cows did not eat it readily at first, but after getting it sprinkled with bran and salt for a few days they ate it readily. While getting accustomed to it the milk flow shrunk considerably, but at the end of the test period, August 19, they had reached a larger flow than at any time during the feeding of sweet corn, and, notwithstanding the shrinkage while getting used to it, the average daily yield of butter fat reached 3.97 lbs., and the last 4 days of the test went over 4 lbs. This shows the value of plants richer in protein than corn is."

The investigation of the several breeds of dairy cattle with reference to their relative value in the production of milk, butter, and cheese, P. COLLIER (*New York State Sta. Rpt. 1893, pp. 10–156, pls 4*).—The record of this extended investigation is continued from

the Annual Reports of the station for 1891 and 1892 (E. S. R., 4, p. 255; 6, p. 68). The record includes 26 cows of the following breeds: Ayrshire, Jersey, American Holderness, Guernsey, Devon, Holstein, and Shorthorn. It covers for some of the cows a part of the first period of lactation, for others parts of the second and third periods, and for 2 cows parts of the third and fourth periods. The data given show for each cow the date of calving, and kinds and amounts of food eaten, the food ingredients eaten, the yield and composition of milk, yield of milk constituents, and general averages for each month of lactation; the relation of fat in the food to fat in the milk in each period of lactation, the cost of production of milk and fat, the percentage variation by months in food and milk constituents, comparisons of successive periods of lactation, and the relative size and number of globules in the milk of each breed in the different periods of lactation; and analyses of mixed hay, corn silage, corn fodder, alfalfa fodder, sorghum fodder, rye fodder, oat and pea fodder, beets, mixed grain, wheat bran, and oats fed in the trial.

Owing to the different periods of lactation in which the cows were, it is impracticable to give any concise statement of the results for the period covered which would not be misleading. The only discussion of the results in the report is with reference to the source of the fat in milk (see p. 1011).

Cotton-seed feed for dairy cows, H. P. ARMSBY and E. H. HESS (*Pennsylvania Sta. Bul. 28, pp. 22*).—"Quite recently there has been brought before the farmers of this State what is designated as 'cotton-seed feed,' which purports to be a mixture of 5 parts of the hulls with 1 of cotton-seed meal by weight. The result is a very bulky feed, weighing about 13 lbs. per bushel, which is offered at the price of $11.50 per ton in bulk in car lots at any point in Pennsylvania."

Analyses of 4 samples of this material and the computed composition of a mixture of 1 part of cotton-seed meal to 5 parts of hulls are given, as follows:

Composition of cotton-seed feed.

Constituents.		Computed 1 to 5.	Sample No. 14510.	Sample No. 15966.	Sample No. 16034.	Sample No. 16562.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Water		13.07	13.07	13.07	13.07	13.07
Ash		3.28	2.45	3.39	2.55	2.92
Albuminoids	Protein	10.05	6.92	9.51	7.21	10.25
Non-albuminoids			.88	.75	1.22	.40
Crude fiber		36.61	43.28	33.12	32.54	34.31
Nitrogen-free extract		33.22	30.67	36.77	40.66	36.01
Fat		3.77	2.73	3.39	2.75	3.04
Total		100.00	100.00	100.00	100.00	100.00

The cost of a mixture of 1 part of cotton-seed meal to 5 parts of hulls is reckoned at $10.42 per ton, plus the cost of mixing.

The digestibility of cotton-seed feed was determined in an experiment with 3 steers. This material was fed alone from March 23 to

April 21, the excreta being analyzed during the last 7 days. The results, together with those obtained at the North Carolina Station with 2 mixtures of cotton seed meal and hulls, are given, as follows:

Digestibility of cotton-seed feed.

Constituents.	Pennsylvania experiments.				North Carolina experiments.	
	Steer 1.	Steer 2.	Steer 3.	Average.	1 of meal to 6 of hulls.	1 of meal to 4 of hulls.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Dry matter	42	45	43	43	46	54
Ash	20	....	24	15	25	46
Protein	36	32	41	36	46	54
Crude fiber	28	33	32	31	40	45
Nitrogen-free extract	53	59	50	54	50	58
Fat	83	86	84	84	82	85

Upon the basis of the above data the digestible food ingredients in 100 lbs. of material, and the cost of the digestible materials (reduced to starch equivalent) in a number of common feeding stuffs, are computed.

"Both as regards bulk, chemical composition, and proportion of digestible matter the cotton-seed feed corresponds more nearly to a coarse fodder than to a grain feed. The results of our digestion experiments show it to contain rather less total digestible matter than either clover or timothy hay and a little more than good corn fodder. It has, however, a somewhat larger proportion of protein than either corn fodder or timothy hay but less than clover hay. In proportion to the amount of digestible matter which it contains it is a relatively expensive feed, costing more per pound of digestible matter than any of the feeds named in the table with the exception of cotton-seed meal. The indications of the digestion experiments, therefore, are that the feed contains only a moderate amount of actual food and that it is too costly to compete with more familiar feeding stuffs."

Two feeding trials were made to test cotton-seed feed, each with 2 lots of 3 cows each. In the first trial a ration of 8 lbs. of bran and cotton-seed feed *ad libitum* was compared with one of 7 lbs. of corn meal, and 3 lbs. of cotton-seed meal with corn fodder and clover hay *ad libitum.* These were fed in 2 alternating periods of 21 days. The milk was weighed and composite samples taken for testing. Some difficulty was experienced in inducing the cows to eat the cotton-seed feed.

The 2 rations contained practically the same amount of dry matter, but the cotton-seed feed ration contained considerably less digestible matter, owing to its low rate of digestibility. The average results of the trial are summarized in the following table:

Average results of comparison of rations on milch cows.

Ration.	Average daily yield.			Cost of food per pound of product.			Net profit per head daily.	
	Milk.	Milk solids.	Butter fat.	Milk.	Butter fat.	Butter.[1]		
	Pounds.	*Pounds.*	*Pound.*	*Cent.*	*Cents.*	*Cents.*	*Cents.*	*Per cent.*
Hay and corn fodder ration	16.94	2.194	0.745	0.77	17.50	14.87	11.77	90.27
Cotton-seed feed ration	13.74	1.828	.670	.89	18.34	15.59	9.74	79.24

[1] Assuming 0.85 lb. of butter fat to make 1 lb. of butter.

The cost and profit are based on hay at $10, corn fodder $4, corn meal $18, cotton-seed meal $26, bran $14, and cotton-seed feed $11.50 per ton, butter at 25 cts. per pound, and skim milk at 20 cts. per 100 lbs.

"A ration of cotton-seed feed and bran produced 19 per cent less milk and 10 per cent less butter than one of corn fodder, mixed hay, corn meal, and cotton-seed meal containing an equal amount of dry matter.

"The feed cost per pound of milk was 13 per cent lower and per pound of butter 5 per cent lower on the hay and fodder ration than on the cotton-seed feed ration.

"The net profit per day and head was 17 per cent less on the cotton-seed feed ration than on the hay and fodder ration."

The experiment was repeated, using a second lot of cotton-seed feed. The general plan of the experiment was practically the same as the first, the lots being reversed on the rations. Each lot received 2 lbs. of bran and 6 lbs. of Buffalo gluten meal per head daily, and one lot had clover hay, while the other had cotton-seed feed *ad libitum* as coarse fodder. Four pounds of corn meal was fed to offset the cotton-seed meal in the cotton-seed feed, but this turned out to be too much, as the cows did not eat as much of the feed as was anticipated. From 9½ to 12½ lbs. of the cotton-seed feed was eaten daily, which would contain less than 2 lbs. of cotton-seed meal.

The average daily yield on the cotton-seed feed ration was 15.25 lbs. of milk and 0.763 lb. of butter fat, and on the clover hay ration 17.9 lbs. of milk and 0.814 lb. of butter fat.

"As in the former experiment, the cotton-seed feed ration produced less milk and butter than the ration with which it was compared. . . .

"The financial results of this experiment are slightly in favor of the cotton-seed feed ration, and thus apparently contradict those of the previous trial. It is to be borne in mind, however, that in this second trial the cotton-seed feed was compared with a heavier ration. . . .

"Plainly, however, the first method of comparison is the one best adapted to give a fair idea of the value of the new feed, and hence we shall give much more weight in our conclusions to the results of the first experiment."

The authors' conclusions are:

"(1) The results of these investigations indicate that cotton-seed feed is too expensive, in proportion to the amount of food which it contains, to successfully compete on equal terms with ordinary dairy foods at average prices.

"(2) The results of these experiments show that under average market conditions a very considerable profit may be realized by the conversion of dairy foods into milk and butter. The net profit over the estimated cost of feed and care in these experiments ranged from 77 to 95 per cent."

Pig feeding, different breeds, W. P. WHEELER (*New York State Sta. Rpt. 1893, pp. 224–234*).

Synopsis.—Two experiments in feeding young pigs of different breeds from birth until a little over 7 months old, in one case, and until 10 weeks old in the other. In the experiment for 7 months the average gain, cost of gain, and shrinkage in dressing were practically the same for all breeds. In the other experiment the Poland China and Berkshires made slightly the best gains, but the Duroc and the Duroc-Poland China cross the most economical.

The record is given for 8 Berkshires, 8 Poland Chinas, and 6 Poland China-Duroc cross fed from birth until a little over 7 months old, and for 3 Berkshire-Cheshire cross until 4½ months old. They were kept

with the sows until they had learned to eat readily from the trough. They were fed skim milk, to which wheat bran was added during the first 4 weeks, a mixture of equal parts of bran and middlings during the next 5 or 6 weeks, and the same with increasing amounts of corn meal during the remainder of the trial. The nutritive ratio increased from about 1:2.5 at the beginning to about 1:5.8 at the close.

In calculating the cost of food bran is rated at $18, middlings at $20, and corn meal at $22 per ton, and skim milk at 25 cts. per 100 lbs.

"The average weight of the Berkshire pigs at beginning was 3.7 lbs., of the Poland China 2.9 lbs., and of the Poland China-Duroc cross 3.7 lbs. The average weight of the Berkshire-Cheshire cross was 2.1 lbs. At the close of the feeding trial, which lasted a little less than 7 months, the Berkshires averaged 198.8 lbs. in weight, the Poland Chinas 196.5 lbs., and the Poland China-Duroc cross 197.8 lbs. All the pigs were entirely healthy throughout the trial. The cost of all gain made for the whole trial, was for the Berkshires 3.82 cts. per pound, for the Poland Chinas 3.76 cts., for the Poland China-Duroc cross 3.80 cts.—practically the same for all. The Poland China pigs were ready to leave the sow about a week younger than the others. The Berkshire sow lost most in weight while suckling the pigs and the Poland China the least. The cost of food to restore the weight lost was for the Poland China sow 12.41 cts. per pound, for the Berkshire 5.88, and for the Duroc 4.96 cts. per pound. Six pigs from each lot were killed and dressed at the end of the trial and the average loss in weight by dressing was for the Berkshire 22.9 per cent, for the Poland China 21.8 per cent, and for the Poland China-Duroc cross 22.3 per cent. In the feeding experiment made the year before with Poland China, Duroc, and Berkshire pigs at a time when little skim milk was available and only grain was fed, the Poland China made a much more profitable growth than the others."[1]

The record is also given for a number of Poland Chinas, Berkshires, Durocs, and Poland China-Duroc cross fed for 10 weeks, being kept with the sows during the whole trial.

"For the first 5 weeks the food was skim milk and wheat bran, and for the next 5 weeks skim milk and mixed grain, consisting of equal parts of wheat bran and ground oats. . . .

"At the end of 10 weeks the average weights were 37 lbs. for the Poland China, 38.8 lbs. for the Berkshire, 31.1 lbs. for the Duroc, 33.6 lbs. for the Poland China-Duroc cross. . . .

"For the first period the gross cost of the gain made was least for the Poland China-Duroc cross, but considering the value of weight lost by the sow at the cost of afterwards restoring it, the Berkshire pigs made the most profitable gain. For the second period the gross cost of increase of weight was least for the Poland China-Duroc cross, and considering the cost of weight lost by the sow, the cost of the weight gained was least for the Durocs."

Pig feeding, wet and dry feed, W. P. WHEELER (*New York State Sta. Rpt. 1893, pp. 219–223*).

Synopsis.—Two trials to compare the same grain food when fed dry and when soaked. In the first trial both lots of pigs had the same quantity of food, but in the second it was given *ad libitum.* In the first trial the gains were the same on wet and dry feed, but in the second the lot on soaked grain ate a little more and made a slightly greater and more economical gain.

First trial (pp. 219–221).—Fourteen pigs, Poland Chinas, Berkshires, and Durocs, averaging 138 lbs. each, were divided into 2 lots and fed

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[1] E. S. R., 6, p. 70.

like amounts of food from June 8 to September 4. The food for lot A was mixed with 2 or 3 times it weight of water and allowed to stand 24 hours before feeding, while that for lot B was fed dry. It consisted of corn meal and a mixed grain, which was varied as the feeding advanced. Water was kept before both lots. The results for each lot are tabulated, based on the average per day per 100 lbs. live weight.

"The total gains made by each lot for the whole trial were almost exactly the same—549 lbs. for lot A and 548 lbs. for lot B. The total food consumed was the same for each lot. Considerable more water was taken by the lot having the wet food. . . .

"The wet food for lot A was always eaten very much faster. . . .

"The average loss in dressing for market was 22.8 per cent for lot A and 22.2 per cent for lot B—practically no difference."

The lot on dry food made the steadier gain.

Second trial (pp. 222, 223).—In this 2 lots of 8 pigs each were used, averaging 133 lbs. in weight, and including Poland Chinas, Berkshires, Durocs, Chester Whites, and a Berkshire-Cheshire cross. The food consisted of corn and a mixture of wheat bran, cotton-seed meal, linseed meal, and middlings, and was fed *ad libitum*. The trial lasted from February 9 to April 13. The results are tabulated as for the first trial.

"The hogs in lot D having the food which was mixed with water and soaked about 24 hours ate a little more than those in lot C having dry food, and made a slightly more economical gain, the cost of the gain in weight being 4.7 per cent less than for the lot having dry food. Lot D took a very little more corn meal in proportion to the mixed grain than did lot C, and the nutritive ratio of their ration was very slightly broader in consequence.

"There was an excessive quantity of food taken by the hogs in both lots, and 2 hogs in lot D suffered from indigestion, etc., after the close of the trial, and 1 (Duroc) died from congestion of liver following indigestion. The increase in weight, as in the first feeding experiment, was less regular with the lot having wet food. . . .

"After the close of the feeding trial the average loss in dressing 5 hogs from lot D was 24.2 per cent, and the average loss in dressing the 8 hogs in lot C was 22.5 per cent."

Horse feeding, R. WARINGTON (*Jour. Bath and West of Eng. Soc., ser. 4, 4 (1893–'94), pp. 188–196*).—In this article the author gives a concise review of the experiments by A. Müntz on the horses of a tramway company in Paris, those by Grandeau and Leclerc (still in progress) on the horses of a cab company, and those of Wolff at Hohenheim, upon which "nearly the whole of our exact knowledge of horse feeding depends."

Some of the difficulties in the way of arriving at certain fixed data to guide in horse feeding are enumerated.

"Horses are not so generally alike in their powers of digestion, nor in the use they make of food, as a flock of sheep or a herd of cattle. This is, perhaps, partly because the sheep and cattle are always in repose, while the horse being worked to the full extent of his powers any individual weakness becomes apparent. The horse, too, is kept in work till old age, and we consequently have to deal with him both in strength and feebleness. Baudement placed 168 of the French cavalry horses on the same rations and studied the alterations in weight of each horse; he found that horses which were above the mean height, above the mean weight, and below the average age gave the best return for the food consumed."

With reference to the use of coarse fodders the author says:

"Although bulky foods, such as hay or straw chaff, are necessary ingredients of horse rations, a horse is by no means so capable of digesting vegetable fiber as an ox or sheep; the horse, in fact, is not provided with the digestive apparatus belonging to ruminant animals. In Wolff's experiments at Hohenheim, in which the same diet was supplied both to a horse and sheep, the horse succeeded worst in his digestion of the fiber of straw chaff, of grass, and of meadow hay, while in the case of clover and lucern hay he nearly equaled the sheep in digestive power. Wolff in his last report comes to the remarkable conclusion that the fiber digested by a horse is of no value, either as a means of sustenance while at rest or for the production of work. No direct proof of this is furnished; the conclusion is drawn from the lower nutritive and force-producing value of the digested matter of diets including hay. The conclusion has not been generally accepted, and the facts will, perhaps, bear another interpretation."

Experiments on the amounts of food required by a horse at rest, with only sufficient exercise to preserve health, are summarized.

"In Grandeau's experiments with meadow hay alone as the diet 3 horses were kept at rest for various times, amounting in all to 4 or 5 months each, half an hour's walking exercise being allowed per day. Each horse received 17.6 lbs. of hay per day, and this proved exactly sufficient to maintain their weight unaltered. The amount digested by each horse was determined through the whole period by analysis of the solid excrements. The 3 horses did not digest the hay equally well, and thus each horse was really nourished and its weight maintained by somewhat different amounts of food. The average result of 3 months' feeding for each horse was as follows:

Digestible matter required per day for maintenance of horses at rest.

	Live weight of horse.	Dry organic matter digested per day.	
		Actual.	Per 1,000 lbs. live weight.
	Pounds.	*Pounds.*	*Pounds.*
No. 2	897	5.90	6.57
No. 3	853	5.98	7.00
No. 1	806	6.31	7.82
Mean of 3 horses for 14 months			7.02

"Grandeau and Leclerc experimented with many other diets, but in only a few cases did their maintenance diets exactly meet the wants of the horse. The results in these cases are given in the next table, but the results with other diets are of far less authority than those obtained in the more extended experiments with meadow hay.

Dry matter in maintenance rations for horses.

Diet.	Weight of horse.	Dry organic matter per day.		
		In ration.	Digested.	Digested per 1,000 lbs. live weight.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
Hay alone (mean)	868	14.08	6.09	7.02
Maize and oat straw	1,013	11.57	8.33	8.22
Maize, oats, hay, and straw	972	9.48	7.30	7.50
Do	906	9.49	6.74	7.45
Oats alone (crushed)	913	8.59	6.41	7.02

The minimum quantity of albuminoids required to replace the daily waste of the body, judging from the French experiments, must be extremely small. The 3 horses observed by Grandeau received, on an average, 0.538 lb. of digestible albuminoids per 1,000 lbs. live weight daily. But there is evidence that this is not the minimum amount, for one horse averaged only 0.447 lb. of digestible albuminoids per 1,000 lbs. live weight during 2 months, and gained 5 lbs. in weight; and in another case the same horse gained somewhat on a ration of 0.37 lb. of digestible albuminoids. In view of the data at hand, the author is inclined to regard about 0.45 lb. of digestible albuminoids per 1,000 lbs. live weight as the minimum quantity per diem for the maintenance ration of a horse. This makes the nutritive ratio very wide; in the case of the horse cited above it was only 1:12.8.

"Müntz studied the digestive functions of the horse by killing 2 of little value a few hours after they had been fed, and analyzing the contents of the stomach and of successive portions of the intestines separately. One horse had been fed on hay and one on wheat bran. It appeared that all ready-formed sugar was absorbed in the stomach. Starch did not disappear in the stomach; it is digested subsequently by the pancreatic juice. When the food consisted wholly of bran, more than half of the albuminoids and a considerable proportion of the cellulose disappeared in the stomach; but when the food consisted of hay, no assimilation of albuminoids, and scarcely any of cellular matter, took place in the stomach. It is difficult to tell what occurs shortly after leaving the stomach, owing to the large quantity of digestive fluids (bile and pancreatic juice) which are poured into the canal. The largest amount of absorption apparently occurs in the large intestines and colon, and it is here that the most striking diminution takes place in the various cellulose constituents."

In this connection the effect of labor on digestion, as shown by Grandeau and Leclerc's experiments, is interesting.

"Taking the mean of a very large number of experiments with different diets, and taking the proportion of organic matter digested while at rest as 1,000, we have the following series of figures as representing the proportion digested during different degrees of labor:

Relative proportion of food digested.

At rest	1,000
Walking exercise	1,032
At work walking	1,007
Trotting	976
At work trotting	973
At work in cab	959

"We see here that the moderate exercise is accompanied by a small but distinct improvement in the digestive functions, but that as soon as trotting commences digestion becomes less efficient than when at rest, while hard work while trotting still further diminishes the proportion of food digested. When we look into the details we find that the starch and sugar in the food are perfectly digested under all conditions of labor. The digestibility of the fat increases with exercise and does not diminish by labor below the point reached in repose. The digestibility of the albuminoids increases rather considerably with exercise and diminishes sharply when trotting commences. The principal matters usually grouped as 'soluble carbohydrates,' but which in this case are merely the more digestible constituents of the

fiber, undergo the greatest amount of variation, their digestibility rising considerably with exercise and falling still more considerably with hard labor. In the case of the more insoluble portion of the fiber there is no rise in digestibility by exercise; the maximum rate of digestion is here obtained in repose, and diminishes considerably with increased bodily exertion. On the whole it appears that the constituents of the food which are most affected by rapid exertion are those whose digestion takes place to a large extent in the lower part of the intestines; the motion of the horse probably determines their more rapid passage through the system."

Grandeau's experiments have brought out the marked influence of pace on the amount of labor performed and the food required.

"Thus a horse walking 12½ miles per day was kept in condition with a daily ration of 19.4 lbs. of hay, while a ration of 24 lbs. of hay was insufficient when the same distance was done trotting. Again, a horse walking the above distance and dragging a load, the additional work being equivalent to 1,943 foot-tons, was sufficiently nourished by a ration of 26.4 lbs. of hay; but a daily ration of 32.6 lbs. (all that the horse would eat) was not enough to maintain the horse's weight when the same work was done trotting."

Some of the reasons mentioned why rapid work is less economical than slow work are the increased work of the heart when the horse is trotting or galloping; the lifting of his own weight at each step, only to allow it to fall again, developing heat; the increase of temperature with exertion, and the loss of heat by evaporation of water through the skin and lungs.

"The mean quantity of water evaporated daily, under different conditions of exercise, as determined in experiments with 4 different diets, was as follows:

Water evaporated per day.

	Pounds.
At rest	6.4
Walking exercise	8.6
At work walking	12.7
Trotting	13.4
At work trotting	20.6

"As already explained, the distance trotted was the same as the distance walked, and the load drawn when trotting the same as when walking. The heat consumed in the evaporation of water is very considerable; the loss of water in the breath and perspiration thus necessitates a consumption of food to produce this heat, and diminishes considerably the quantity of food available for the production of work."

As to whether a nitrogenous ration is or is not essential for horses at hard work, it is said that Grandeau's researches do not furnish any information, but that we have to rely chiefly on the investigations of Wolff and of Müntz.

"The doctrine laid down by Wolff and his fellow-workers at Hohenheim is a very simple one. He distinguishes between the food necessary to maintain the horse at rest without loss of weight and the extra food which must be given when work is performed, if the horse is again to be maintained without its weight suffering loss. Between the weight of digestible matter in this extra food and the quantity of work accomplished there is a tolerably uniform relation. Wolff reckons that digested nutritive matter equivalent to 100 gm. of starch is capable of producing 85,400 kilogrammeters of work, or, expressed in English terms, 1 lb. of starch digested by a horse will accomplish 1,232 foot-tons of work. This is 48 per cent of the full work which

the starch could accomplish if burned outside the body. This result is the average of many experiments with different diets.

"The horse requires for his maintenance in weight while at rest a certain daily supply of albuminoid substance, which must never fall below a certain quantity; but the extra food given when work is to be performed may consist indifferently of any digestible combustible substance, whether albuminoids or not. The horse keeper is thus at liberty to select from a wide range of foods, and is not obliged to give a preference to those which are specially nitrogenous. It should, however, be borne in mind that what has just been said applies strictly only to horses which are already in good working condition. Horses which are low in condition, and must gain in weight of muscle before they are fit for hard work, must, of course, receive a more nitrogenous diet."

The author finds it impossible to state exactly the nutritive ratio of the rations fed by street railway companies in England, as the composition of the foods fed is not known definitely; but from the rations published he fixes the ratio at from 1:7 to 1:8.

Poultry, W. P. WHEELER (*New York State Sta. Rpt. 1893, pp. 214–219*).—The plan is given of a breeding experiment which has now been in progress for 2 years at the station, and a detailed statement of the cost of raising young fowls. About 130 Cochin and Leghorn chickens were hatched by the natural method, for the special purpose of obtaining pullets for use in a feeding experiment. Of the Cochin eggs set 46.1 per cent produced healthy chicks, and of the Leghorn eggs 75.2 per cent. Counting eggs at 24 cts. per dozen, and the food eaten by the sitting hens at local prices, the cost of each chick when hatched was 4.65 cts. for the Cochins and 2.82 cts. for the Leghorns. The hens were kept with the chickens from 5 to 6 weeks. The food of the growing chickens was cracked wheat, skim milk, desiccated beef, finely cut fresh bone, and mixed grain, which was varied from time to time. The chickens remained entirely healthy, and only a few were lost from accidents. The sexes were separated when the Cochins averaged 109 days old and the Leghorns 84 days. At that time the Cochins averaged 4.05 lbs. and the Leghorns 1.83 lbs. The average total cost per chick (including hatching) amounted to 24.36 cts., or 6.01 cts. per pound, for the Cochins, and 12.59 cts., or 6.88 cts. per pound, for the Leghorns.

The pullets of both breeds were fed 11 weeks longer, at an average cost per fowl of 20.07 cts. for the Cochins and 13.09 cts. for the Leghorns, at which time the Cochin pullets averaged 5.53 lbs. and the Leghorns 2.81 lbs. Deducting from the total cost to date the local market value of the cockerels at the time the chickens were separated gives the net cost of the Cochins at 13.24 cts. each and of the Leghorns 16.78 cts.

"The sexes were about equal with the Cochins, but there was an unusual excess in the number of pullets among the Leghorns hatched (37 per cent more pullets than cockerels), so that the poultry value of the cockerels represented a lesser proportion of the value of food consumed. Had the sexes been equal, at the same proportionate cost for growing, and considering the poultry value of the cockerels, the net cost of Leghorn pullets would have been 13.55 cts. apiece, nearly the same as that of the Cochins."

Human food articles (*Massachusetts State Sta. Bul. 57, p. 2*).—Analyses with reference to food ingredients of roasted oats, Hecker's oatmeal, rolled avena, and rolled oats.

Analyses of fodder articles (*Massachusetts State Sta. Bul. 57, pp. 3–5*).—Analyses of Canada hay, linseed meal, Chicago maize feed, wheat bran, corn products, oat feed, Atlas meal (dry distillery feed), and water grass (sedge), the last two with reference to fertilizing ingredients.

Does the palm-nut meal obtained in the extraction process contain carbon bisulphid or other objectionable substance? W. SONNE and A. SCHMIDT (*Ztschr. landw. Ver. Hessen, 1895, No. 10, pp. 73, 74*).—After describing the method by which the meal is obtained in the extraction of oil from palm nuts by carbon bisulphid, the authors mention 2 experiments with meal from a factory in Darmstadt. This meal was found to be entirely free from bisulphid or other similar substance of objectionable smell or taste.

Oleomargarin, a hygienic study, A. JOLLES (*Abs. in. Chem. Ztg., 19 (1895), No. 10, Repert., p. 32*).

Feeding stuff from peat and molasses, A. WAGNER (*German patent; Chem. Ztg., 19 (1895), No. 31, p. 713*).

Detection of adulterants in olive oil, A. MÜNTZ (*Bul. Min. Agr. France, 14 (1895), No. 1, pp. 89–126, fig. 2*).

Digestion of fat in the stomach, C. CONTEJEAN (*Arch. de Physiol. [5], 6, I, p. 125; abs. in Centbl. Physiol., 8, p. 581, and in Chem. Centbl., 1895, I, No. 3, p. 164*).

Digestion products of casein and their phosphorus content, W. VON MORACZEWSKI (*Ztschr. physiol. Chem., 20, No. 1 and 2, pp. 28–51; abs. in Chem. Centbl., 1894, II, No. 23, p. 919*).

The nuclein resulting in the pepsin digestion of casein, J. SEBELIEN (*Chem. Ztg., 18 (1894), No. 102, p. 2018*).—A preliminary note.

How to make the most of the cow in winter, A. POTTIE (*Jour. Bath and West of Eng. Soc., ser. 4, 4 (1893–'94), pp. 208–212*).—The author argues for warmer stables in winter, and gives the results of his experience and observation with thermometers. He recommends 63° F. as the proper temperature for a cow stable in winter. The cows not only give more milk, in his experience, but are kept in better condition than when the temperature is colder or much warmer. He cites two striking instances in which the milk yield of herds was materially increased and their condition improved by raising the temperature of the cold stables to about 63°.

Cattle feeding, W. P. WHEELER (*New York State Sta. Rpt. 1893, pp. 212–214*).—Remarks on the kinds of food fed in different parts of the year in the test of breeds of dairy cows.

Organized cottage poultry keeping, G. F. C. PYPER (*Jour. Bath and West of Eng. Soc., ser. 4, 4 (1893–'94), pp. 71–82*).

VETERINARY SCIENCE AND PRACTICE.

Experiments with tuberculin on non-tuberculous cows, J. LAW (*New York Cornell Sta. Bul. 82, pp. 659–676*).—Five healthy cows, 3 of which were giving milk, received weekly full doses of tuberculin, and their temperature was taken every 2 hours, from 9 to 20 hours after injection, and compared with their normal temperature. These injections exercised no noticeable influence on the temperature of the animals, yield of milk, or on the percentage of fat in the milk. "There is nothing in the record of temperatures that would indicate, either at the time of the injection or later, that the tuberculin would prove inimical in any way. So far as there is evidence before us, everything points to the harmlessness of a single test dose on a sound system."

The temperature, yield of milk, and percentage of fat in the milk are tabulated for each animal used in the experiment.

Variability of Bacillus anthrax, A. CHAUVEAU and C. PHISALIX (*Compt. Rend., 120 (1895), No. 15, pp. 801–807, fig. 1*).—A new variety is described, *B. anthracis claviformis.*

Reports of the veterinary colleges of Alfort, Lyons, and Toulouse (France), TRASBOT, ARLOING, and LAULANIE (*Bul. Min. Agr. France, 14 (1895), No. 1, pp. 59–89*).

Report of the Royal Commission on tuberculosis (*Nature, 52 (1895), May 2, pp. 19, 20*).—A summary.

DAIRYING.

The treatment of milk in the stable (*Landw. Wochenbl. Schles. Holst., 45 (1895), No. 11, pp. 169, 170*).—Extracts from a talk by Prof. Fleischmann before a convention of coöperative creamery delegates. The lack of cleanliness in milking is emphasized as a most important cause of inferior dairy products. In Bavarian Algau the creameries forbid straining the milk and require that it be delivered just as milked, in order that they may judge of the cleanliness exercised in the stable by each patron. Their unstrained milk is without doubt cleaner and keeps better than the ordinary carefully strained milk of Schleswig-Holstein. It is stated that in Switzerland the milking is done with the bent thumb and first two fingers, so that the milk can not come in contact with the hand.

Another serious error mentioned is allowing the milk to stand in the stable after milking, and this is far greater where the milk is cooled there with a milk cooler, as is often done. The utmost cleanliness in the care of the cows and in milking is insisted upon as requisite to the finest quality of dairy products, and the further this is departed from the greater the difficulty in making good products. "All the results of scientific investigation which have found such great practical application in the treatment of diseased wounds, in disinfection, and in preserving various products are almost entirely ignored in milking."

Trials of cream-raising systems (*Jour. Bath and West of Eng. Soc., ser. 4, 4 (1893–'94), pp. 200–207*).—Two series of trials were made under "very unfavorable conditions" to compare the separator (Alpha Baby, hand power), Jersey creamer, shallow pan, and scald cream method. In the latter the milk after being set was scalded on one of the milk scalders commonly used in Devonshire.

"[The Jersey creamer] consists of a series of metal vessels in which the milk is set at a high temperature. These vessels are jacketed; that is, they have an outer coat which can be filled with water and through which a stream of cold water can flow. The vessels are provided with covers to keep dust from settling upon the cream, but so constructed as to permit of a free circulation of air above the cream. The skim milk is drawn off through a very fine metal sieve, which does not permit the cream to pass through it. When all the skim milk has been removed this sieve can be withdrawn and the cream collected in a separate vessel."

In each trial butter was made from the cream, and analyses of the butter are given. The proportion of the total fat in the milk which was recorded in the butter in the 2 trials was as follows: Separator, 88 and 87.5 per cent; Jersey creamer, 77.5 and 69 per cent; shallow pans, 81 and 78.5 per cent; scald cream, 76.5 and 65.6 per cent.

A fungus on butter, E. J. McWeeney (*Jour. Roy. Agl. Soc. England, ser. 3, 5 (1894), No. 19, pp. 567–569, figs. 5*).—The author describes and figures a fungus causing dark brown spots on butter. It corresponds to a fungus said to infest the wood used for making butter boxes. It is not mentioned as troublesome as yet.

Observations on Cheddar cheese-making, F. J. Lloyd (*Jour. Bath and West of Eng. Soc., ser. 4, 4 (1893–'94), pp. 131–176*).—A large amount of tabulated data obtained principally in connection with the Bath and West of England Society's cheese school, including the analyses of the milk, whey, curd, and cheese, together with some bacteriological observations previously referred to (E. S. R., 6, p. 481).

"The results of this year's work confirm in every particular the conclusions which have been come to in previous reports. It is scarcely necessary to reiterate the conclusions come to in this report.

"The work of three years may be summarized as follows:

"To make Cheddar cheese of excellent quality, one, and one single organism only, is necessary in the milk, that is the *Bacillus acidi lactici*; every other organism present will tend to make the work more difficult. Hence it is imperative that scrupulous cleanliness be the primary consideration of the farmer and of the cheese-maker, as of all those who have in the least possible respect to deal with the cows, the milk, or the apparatus employed.

"Secondly. No matter what system of manufacture be adopted, two things are necessary—two results must be obtained. The one is that the whey be separated from the curd, so that when the curd is ground it shall contain not less than 40 per cent of water, nor more than 43 per cent; and the other is that the whey left in the curd shall contain developed in it before the curd is put in the press at least 1 per cent of lactic acid if the cheese is required for sale within 4 months, and not less than 0.8 per cent of lactic acid if the cheese is to be kept ripening for a longer period.

"Lastly. The quality of the cheeses which comply with the foregoing standard will vary according to the quality of the milk from which they have been made, and, proportionately, to the amount of fat present in that milk. The fat is the constituent which most affects the quality of the cheeses; hence it is not possible to expect the same quality of cheese to be made from land which yields large quantities of poor milk as from land which yields small quantities of rich milk. But, with due care, the larger yield of cheese which can be obtained from the poorer milk should balance in value that of the higher quality which can be made from the richer milk-yielding pastures."

The sterilization of milk, A. Rodet (*Rev. Hyg., 1894, No. 12, p. 1025; abs. in Centbl. Bakt. und Par. Med., 17 (1895), No. 13–14, pp. 501, 502*).

Concerning butyric acid fermentation, E. Baier (*Centbl. Bakt. und Par. Allg., 1 (1895), pp. 17, 84, 118*).

The business side of the Babcock test, W. H. Jordan (*Rpt. Maine Bd. Agr. 1893–'94, pp. 109–117*).—A paper on the advantage of scientific methods in dairying and describing experiments at the Maine Station to investigate the value of the Babcock test to practical dairymen.

The manufacture of Cheddar cheese, T. C. CANDY (*Jour. Bath and West of Eng. Soc., ser. 4, 4 (1893–'94), pp. 127–131*).—Detailed popular description of the author's method.

Experiments relating to the manufacture of Edam cheese, L. L. VAN SLYKE (*New York State Sta. Rpt. 1893, pp. 244–263, figs. 5*).—A reprint from Bulletin No. 56 of the station (E. S. R., 5, p. 211), with the addition of 4 figures showing press and salting molds.

Experiments relating to the manufacture of Gouda cheese, L. L. VAN SLYKE (*New York State Sta. Rpt. 1893, pp. 264–275, figs. 4*).—A reprint from Bulletin No. 56 of the station (E. S. R., 5, p. 211).

Study of the cheese-ripening process, L. L. VAN SLYKE (*New York State Sta. Rpt. 1893, pp. 276–285*).—A reprint from Bulletin No. 54 of the station (E. S. R., 5, p. 85).

Experiments relating to the manufacture of cheese from normal milk rich in fat, L. L. VAN SLYKE (*New York State Sta. Rpt. 1893, pp. 285–319*).—A reprint from Bulletin No. 54 of the station (E. S. R., 5, p. 85).

Character and extent of investigation made in relation to the manufacture of cheese in cheese factories during the season of 1893, L. L. VAN SLYKE (*New York State Sta. Rpt. 1893, pp. 319–486*).—A reprint of Bulletin No. 65 of the station (E. S. R., 5, p. 892).

Dairying from a business standpoint, G. A. BOWEN (*Rpt. Maine Bd. Agr. 1893–'94, pp. 95–105*).—A general paper recommending accurate and modern scientific methods.

Dairying at the World's Fair, J. GOULD (*Rpt. Maine Bd. Agr. 1893–'94, pp. 133–144*).—A paper briefly discussing the dairy exhibitions at the World's Fair and speaking of their value as public instructors.

General dairy practice, W. D. HOARD (*Rpt. Maine Bd. Agr. 1893–'94, pp. 118–128*).

The progress and conclusions of modern science as applied to practical dairying, W. D. HOARD (*Rpt. Maine Bd. Agr. 1893–'94, pp. 83–90*).—A popular paper on the subject urging the more extensive application among farmers of scientific methods in dairying, the testing of milk, careful feeding, and a systematic study of the herds.

Matzoon, H. J. PATTERSON (*Agl. Sci., 8 (1894), No. 10-11, pp. 447, 448*).—The analysis of this drink made from milk is given.

TECHNOLOGY.

Experiments with corn for brewing, C. SCHUBERT (*Allg. Ztschr. Bierbr. und Malzfabr., 22, p. 888; abs. in Vierteljahr. Chem. Nahr. und Genussmtl., 9, p. 406, and in Chem. Centbl., 1895, I, No. 7, p. 401*).—Experiments in the use of maize for brewing showed that the process was normal and a beer produced which could not be distinguished from normal lager beer by analysis, but had a peculiar taste. The latter is considered disadvantageous to the use of corn for brewing.

The silk industry in France, N. RONDOT (*L'Industrie de la Soie en France. Lyons: 1894, pp. 150*).—This is a comprehensive popular work, largely historical in character, tracing the development of the silk industry in France from the earliest times, and also treating briefly the different processes in the manufacture of silk goods of all sorts, including ribbons, tulles, etc., as well as dress goods. The author states that silk came to us from the Orient, and that Asiatic silk was woven in Europe long before the silkworm itself or the art of drawing threads from its cocoons was known to western peoples. About the middle of the 15th century the true history of silk making in

France begins, the art being in the beginning not so much a trade as a domestic art, mainly practiced by women. In three centuries this paltry industry has become not only one of the first in France but one of the first in the world.

The silk industry has two distinct branches, the first having for its object the production, the second the weaving, of silken threads. The first of these branches is conducted in 24 departments of France, nearly all in the southeastern part of the country, while the manufacture of various silk fabrics is conducted in several large cities, the most important being Lyons. The industry is much subdivided, and it is difficult to make any exact estimate of its proportions, but it is stated that probably 520,000 persons are engaged in it in some way, and that they divide annually 350,000,000 francs in wages and profits. France consumes three tenths of all the silk offered for sale in the world.

The history of silk weaving at Lyons, the most important center of the industry, is treated in chapter X. It started from very small beginnings, being here, as elsewhere, mainly practiced by women, who manufactured narrow strips of silk called tissu or tixu. The industry grew slowly in competition with Italian fabrics, but toward the end of the 18th century was fully established, and after being almost ruined by the French Revolution, revived again in greater vigor than before. A notable tendency of modern silk manufacture has been in the direction of making fabrics only partly of silk, instead of the pure-silk goods once almost exclusively made, the production of such mixed goods having risen from 23,000,000 francs in 1840 to 151,000,000 francs in 1893.

At present the outlook for the silk industry in France is uncertain. The disturbed state of business in general has had its effect here as elsewhere, and the increasing extent to which silk is being made in other countries has lessened to some extent the demand for the French products. Yet from the peculiar fitness of the French people for the delicate manipulations of silk culture and silk manufacture, and in view of the fact that the industry in France has survived other periods of stress, it is thought that French manufacturers of silk will be able by greater exertions to retain the ascendancy in the art which has so long been one of the glories of France. The volume concludes with some statistics (the date of which is not given) of the world's production and consumption of silk, by countries.—R. M. REESE.

Observations on cider making, F. J. LLOYD (*Jour. Bath and West of Eng. Soc., ser. 4, 4 (1893–'94), pp. 98–106*).—An interesting account of experiments in cider making and fermentation.

Cider making, J. HARPER (*Jour. Bath and West of Eng. Soc., ser. 4, 4 (1893–'94), pp. 82–98*).—Detailed popular directions for making cider according to the most approved method.

Investigations on the viscosity of lubricating materials, etc., G. LUNGE (*Ztschr. angew. Chem., 1895, No. 7, pp. 189–191, fig. 1*).

The relation of bacteriology to tanning, F. H. HAENLIEN (*Centbl. Bakt. und Par. Allg., 1 (1895), p. 26*).

Palmetto extract, a new tanning material, SCHNIZER (*Chem. Ztg., 19 (1895), No. 9, p. 167*).

AGRICULTURAL ENGINEERING.

Water supply in Nebraska, O. V. P. STOUT (*Nebraska Sta. Bul. 41, pp. 153–172, map 1*).

Synopsis.—A preliminary report giving all available data relating to the flow of water in the principal streams of Nebraska and discussing the value of the North Platte, the Loup, Republican, Frenchman, South Platte, and Platte rivers for irrigation, with suggestions regarding storage of flood waters and the use of underground water.

In view of the general attention which has recently been directed to Nebraska as a field for irrigation development, the station "has undertaken the collection of facts and the investigation of conditions which have to do directly with irrigation in Nebraska, and the presentation of results and conclusions in a series of bulletins, of which this one may be considered a preliminary or introductory number."

All accessible data relating to the flow of streams in the State, including the results of gauging made under the direction of the station, are given in tables, and estimates, "as definite as the data will warrant, of the capabilities of each stream to supply a perennial flow to canals," are made. A map shows the location of proposed and completed irrigation ditches in Scotts Bluff and Cheyenne counties, along the course of the North Platte River.

"Complete statistics as to the whole amount of land now under ditch in the valley of the North Platte are not at hand, but it is believed to be considerably in excess of 200,000 acres. Under constructed ditch, and under survey with prospect of construction, there are at least 600,000 acres."

From the data thus far collected it is estimated that the total minimum summer flow of this river available for irrigation is 3,150 second-feet and that this in connection with the flood water for which storage facilities are being provided is sufficient for the 600,000 acres included in the various irrigation enterprises in this valley.

"The Loup River, with its several branches and tributaries, is next in importance to the North Platte as a source of supply for irrigating canals. The need for irrigation of the lands which it may water is not, however, so imperative as in the case of the North Platte, but . . . here, as elsewhere in Nebraska, outside the eastern counties, some form or method of irrigation must be devised and put into operation if the agricultural population is to have guaranty of a secure living."

The flow of these streams is very constant, due to the return of seepage water, but the data thus far collected are not sufficient to furnish a safe basis for estimating their capacity for irrigation. Only "the Middle and North Loups, and the main stream below their confluence, present favorable conditions for irrigation development." In other parts of this river system the valleys are so narrow and the adjacent table-lands so high "that even where it is physically possible it is rarely financially practicable or advisable to lead the water to such table-lands."

The Republican River goes dry nearly or quite every summer, and hence can not be relied upon for irrigation. The Frenchman River, however, which flows into the Republican, like the Loup has a steady flow and is being utilized to its full capacity. The area under ditch in the Frenchman and Republican valleys is estimated at a little over 50,000 acres. "The information concerning acres actually irrigated is not complete enough to constitute a basis for a reliable estimate, but the number falls far short of the number of acres under ditch."

Little definite data regarding the Platte and South Platte rivers are given except that "canals of capacity sufficient to utilize the entire amount in dry years are already constructed," and that while the flood value of the Platte is immense the summer flow is very uncertain.

The storage of the flood waters is urged and some of the difficulties encountered in such storage are pointed out.

"The rather discouraging light in which the subject of storage in ponds, lakes, or reservoirs presents itself causes us to turn in another direction as we seek to prevent the flood waters from passing by unused. In the development of one of the most attractive projects now under consideration in the State it is proposed to place entire dependence upon flood water, which is available in great quantity and is practically all that is available. It is proposed to prepare the subsoil of the fields to receive the excess of water which can be furnished at flood period, and to hold it there until it is needed and drawn up by the crops in the dry part of the growing season. The recorded experience of many years in many countries goes to show that a properly prepared subsoil is efficient as a conserver of moisture, and as previously noted, the results of experiments already made encourage the belief that Nebraska soil will prove to be exceptionally efficient in this way."

The utilization of the underground water supply is discussed.

"Irrigation by pumping from wells has not yet been practiced to any great extent in Nebraska. It is almost certain, however, that within the next few years nearly every farmer in the western and middle part of the State, where conditions are at all favorable, will have from 2 to 15 acres under irrigation by this method."

Detailed information on this subject is to be published in a future bulletin of the station.

Progress of irrigation (*Jour. Frank. Inst., 139 (1895), No. 832, pp. 310–312*).—A summary.

Wide tires, R. STONE (*U. S. Dept. Agr., Office of Road Inquiry Bul. 12, pp. 5–16*).—This bulletin includes extracts from State laws, accounts of experiments with wide tires, opinions of correspondents, newspaper notes, and statements regarding the width of tires prescribed by law in various foreign countries. The evidence appears to be overwhelmingly in favor of the adoption of wider tires than are now in general use.

Construction and ventilation of dairy barns, C. F. CURTISS (*Iowa Sta. Bul. 27, pp. 109–112, figs. 2*).—The construction of a barn 40 by 70 ft. in size and costing $4,000 is described, the special feature consisting in the construction of the ventilators, for which purpose the hay chutes and some of the spaces between the studding of the outer wall and between some of the rafters are utilized.

An underground silo, W. W. COOKE and F. L. WATROUS (*Colorado Sta. Bul. 30, pp. 21–23*).—A silo with a capacity of 64 tons was built on the station farm at a cost of 43 cts. per ton of capacity, or 65 cts. per ton including the cost of partitions for 4 compartments. On a spot which remained dry the whole year a hole 21 ft. square

and 8 ft. deep was dug, chiefly with scraper and team. The studs were of 2 by 6 in. lumber resting on a 2 by 6 in. sill and held at the top by a plate of the same size. A single layer of unmatched rough boards, lined with tarred paper, held in place by perpendicular slats, constituted the sheathing. The dirt was filled in against the sides. The silo had no roof, and the silage, covered with straw and 6 in. of moistened dirt, was well preserved.

STATISTICS.

Reports of director and of treasurer of New York State Station (*New York State Sta. Rpt. 1893, pp. 1–211*).—This includes a financial report for the fiscal year ending September 30, 1893; a brief survey of the work and list of bulletins for the year; the needs of the station; World's Fair exhibit of fruits and vegetables and awards to the station, and gifts to the station, together with reports on investigations of breeds of dairy cattle, sources of fat in milk, inspection of commercial fertilizers, and several other studies, all of which are noticed elsewhere under the appropriate headings.

Proceedings connected with the celebration upon the completion of the station building and the organization of the Sheep Breeders and Wool Growers' Association, the State Horticultural Society, and the State Dairy Association, April 5, 1894 (*West Virginia Sta. Special Bul. 2, pp. 82, figs. 17, pl. 1*).

Contribution to the statistics of the indebtedness of the farmers of lower Hesse, C. HUBACH (*Landw. Jahrb., 23 (1894), No. 6, pp. 1035–1043*).

NOTES.

California University and Station.—The State legislature at its recent session gave to the university a special appropriation of $250,000 for a building for the affiliated colleges. It abolished the State Viticultural Commission, to take effect January 1, 1896, transferred the duties of the commission, with a valuable library and set of instruments, to the station, and appropriated $5,000 to carry on its work during the next 2 years; the same appropriation was made for the forestry stations of the university. A dairy bureau has been established by the legislature for the purpose of preventing fraud in the sale of butter and cheese, and its analytical work will be done by the station.

The "alkali soil" question, especially covering the rise and fall of alkali in the soil at the Tulare station during wet and dry seasons and the amounts necessary to seriously affect plant growth, is a prominent subject of investigation, and an extensive series of analyses is being made. The value of the Australian salt bush (*Atriplex semibaccatum*) upon the alkali lands of the State, as food for sheep and cattle at least, has been demonstrated.

Prof. E. L. Greene, the botanist of the station, has resigned, to take effect in June.

During the past year the weight of station bulletins and reports distributed was about 10,000 lbs.

Minnesota University and Station.—A $40,000 dormitory and dining hall is to be erected for the school of agriculture.

Ample sheep and hog barns are to be erected this summer at the university farm, and the basement of the large experiment station barn is being entirely refitted for experiments in feeding dairy and beef cattle.

The dairy hall is to be enlarged this summer to more than twice its present capacity.

The Minnesota legislature, besides giving the agricultural department of the university $65,000 for buildings, appropriated $20,000 for procuring and equipping 2 subexperiment farms, and $10,000 for their maintenance during the current biennial period.

The entomologist of the station has been provided with $5,000 annually, with which to combat the insect pests of the State. The recent movement of the chinch bug into the wheat districts of this State have awakened the farmers to the need of a warfare upon this pest.

The fields of the university farm have been entirely replatted, each field being divided into series 8 rods wide with 16 ft. alleys between, thus providing plats ranging in size from one twentieth of an acre to 2 acres, for the various field trials.

Cornell University and Station.—Several horticultural schools provided under the State appropriation of $16,000 have already been held with very satisfactory results, under the direction of Prof. L. H. Bailey. The schools are from 1 to 5 days duration. Farmers are registered and required to participate in the work. Practical lessons are given in spraying nearby orchards and vineyards.

A great deal of interest is manifested in these schools by fruit growers, and from the number of schools held it seems evident that they are in advance of the good work done in this State by the farmers' institutes.

PERSONAL MENTION.—Dr. R. Sachsse, an agricultural chemist of wide reputation, died at Leipsic, April 25, 1895. Dr. Sachsse was a professor in the University of Leipsic and a frequent contributor to scientific agricultural journals. His book on agricultural chemistry, published in 1888, is widely known.

Dr. J. Brümmer, professor in the University of Jena, and director of the agricultural department of the experiment station of Jena, died March 14, 1895, at the age of 44 years.

Dr. A. von Planta died at Zurich, February 25, 1895, in his seventy-fifth year. Dr. von Planta was never connected officially with any institution but devoted his life to private study in chemical lines, especially the carbohydrates and the chemical activity of bees. A short account of Dr. von Planta's life and works is given by Prof. E. Schulze in *Landw. Vers. Stat., 46, No. 1, pp. 79–84.*

EXPERIMENT STATION RECORD.

VOL. VI. No. 12.

The present number completes the sixth volume of the Record. The extension of the Record work during the year is indicated by the following table, showing the amount of abstracting done for Volumes V and VI, respectively:

	Volume V.	Volume VI.
Station reports	43	42
Station bulletins	267	295
Publications of United States Department of Agriculture	67	78
Foreign articles	227	526
Total number of articles	973	1,606
Classified as follows:		
Chemistry	47	96
Botany	42	53
Bacteriology and zoölogy	10	6
Meteorology	36	86
Air, water, and soil	36	87
Fertilizers	72	95
Field crops	155	398
Horticulture	84	155
Forestry	10	22
Seeds and weeds	24	37
Diseases of plants	66	110
Entomology	74	99
Foods and animal production	119	182
Veterinary science	18	62
Dairying	89	113
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The abstracts in this volume occupy 773 pages, and required in their preparation the reviewing of 28,263 pages in the original publications. In addition to this the volume contains 2,104 foreign titles, not abstracted; 20 editorials, occupying 29 pages; 11 special articles, occupying 138 pages, and 79 station notes, occupying 12 pages.

As in previous volumes, the subject index has been made in sufficient detail to serve as a fairly complete guide to the contents of the publications abstracted.

The classified list of abstracts has been omitted from this volume. The number of articles to be catalogued is so large that it is believed that in most cases references to a given subject will be more readily found in the detailed index than in a voluminous subject list of titles.

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INDEX OF SUBJECTS.